The Electrophysiological Processing of Remote Staring Detection

Ian Scott Baker

Presented in 2006 for the Degree of Doctor of Philosophy in Psychology
at The University of Edinburgh

Declaration

This thesis has been composed by myself, and the work presented in this document is my own. No portion of the work contained in this thesis has been submitted for any other degree or professional qualification.

Ian Scott Baker

Quote

"I know you're watching me, Big Brother!"
My little sister, Melissa Baker, taking part in one of the experiments reported in the thesis

Abstract

This thesis represents the first piece of research to examine the potential electrocortical processing associated with remote staring detection and its potential relationship to face perception in general. The initial step was to conduct a survey examining beliefs and experiences associated with remote staring detection. Using an international, web-based sample it was found that beliefs and experiences were highly correlated, and that belief decreased linearly with the amount of physical barriers placed between the starer and staree. Evidence was also found that belief in remote staring detection and belief in the 'evil eye' could represent different belief structures, and that on certain measures females were more likely to believe in and report experiences of remote staring detection than males. Literature on remote staring detection, the use of electroencephalographic methods, and the importance and processing of eyes and faces is reviewed and discussed.

Three experiments were conducted using several different measures of electrocortical activity (Event-Related Potentials, Global Field Power, Frequency, etc), skin conductance, and questionnaire data. 20 participants for each experiment were isolated, and an automated, double-blind, randomised and counterbalanced protocol was employed. The first experiment found that the addition of a remote stare had no effect on the processing of a blank screen, but significantly reduced the peak amplitude associated with the global processing of faces. The second experiment found the reverse effect, namely that the addition of a remote stare significantly increased the peak amplitude associated with the global processing of both faces and objects. The third experiment replicated the findings of the second experiment concerning the addition of a remote stare having a similar increase in the peak global processing associated with the viewing of faces. However, in a randomised and counterbalanced split-half design, the removal of the starer from the experiment did not change the electrocortical reactions of the staree to the presence of a 'remote stare', leading to further exploration of alternative explanations of the effect. A subsequent

photodiode experiment revealed that there were small and rapid luminance shifts in the initial presentation of the images on the staree's screen for the different conditions which, although extremely small, may have been responsible for the apparent effect of remote staring detection.

The findings of the thesis are then finally discussed in terms of their potential implications for psychophysics and event-related potential studies in general, and for parapsychology as a whole and research on remote staring detection in particular.

Acknowledgements

A PhD is not done in isolation, and I could not have done this alone. There have been a great number of people that have all influenced me in some way during my PhD, and I wish I could thank them all properly. But this would probably result in the acknowledgements being longer than the thesis, which is apparently frowned upon, so I can only highlight some of the people that have been the most important to me during this journey.

To begin with I would like to thank Dr Martin Corley (the internal examiner) and Professor Harald Walach (the external examiner) for their work on assessing my thesis. The comments that they made have helped to significantly improve this thesis and I appreciate them taking the time and effort to evaluate my work.

A special acknowledgement has to go to all of the individuals who gave up their time to take part in my experiments and to complete my survey. Without them I simply would not have had any data and, as a consequence, no thesis.

I would like to thank the different organisations that provided me with funding which enabled me to conduct the PhD. The Bial Foundation was very generous with their funding (Grant No. 30/02) and this money provided the backbone of my funding, and I would like to thank Dr Luís Portela specifically because if he had not have set up the Bial Foundation I simply would not have been in a position to do the PhD. The Society for Psychical Research (SPR) generously gave me two separate rounds of funding at times when I really needed all of the funding I could get. The Parapsychology Foundation kindly awarded me the Eileen J. Garrett Scholarship in 2004. Although this scholarship provided me with a financial benefit, it was the award itself which provided me with an enormous confidence boost that was the most welcome. Finally, the Inova Foundation provided the Koestler Parapsychology Unit with a grant in order to obtain all of our equipment, including the core systems and EEG system which I used extensively during the PhD.

Throughout the PhD there have been people that have provided me with advice and help about the technical aspects of my research. The use of EEG methods proved to be very difficult and highly complex, and although I managed to teach myself many of the concepts and the practical issues surrounding the use of these methods, I would not have been able to progress as far as I have without the help of these individuals. Dr Peter Caryl, one of my supervisors, provided wise council and help when I was designing and interpreting the findings of my experiments. Without the help of Dr Graham Jamieson I doubt I would have been able to grasp the basic concepts surrounding the measurement of EEG, and I am indebted to him for the time I was able to spend with him at Imperial College in London. I am similarly appreciative to Dr Curtis Ponton, Chief Scientist at Neuroscan, and Miguel Rodriguez, head of Advanced Medical Equipment, who provided me with a Scholarship to attend the 2004 Neuroscan Training School which greatly helped to consolidate my knowledge concerning EEG. I am particularly appreciative of the help given to me by Professor Dietrich Lehmann and Dr Jiri Wackermann. I don't think that I will ever forget asking Professor Lehmann what he did, to which he replied that he did "a little EEG", to which I eagerly replied that I was doing that too! I did not realise what a huge impact of the field he had made, and I greatly appreciate the time he took to introduce me to some core concepts and to the Global Field Power measure. I also appreciate the time that Dr Wackermann took with an over-eager PhD student at a conference, where he helped me to see the flaws in my logic. I felt like I had won the Nobel Prize when I got feedback a year or so later from him and he told me that he would have done exactly as I did. In terms of the parapsychological components of the PhD, I appreciate my conversations with my like-minded colleague Dr Stefan Schmidt, who knows a tremendous amount about the remote staring detection literature, and also my colleagues at the Koestler Parapsychology Unit who were always willing to discuss new ideas. I would also like to thank Dr David Donaldson for chatting to me about the issues surrounding ERPs, and Professor Vicki Bruce and Dr Stephen Langton for providing me with extensive introductions to the face processing and gaze processing literature respectively. Finally, I would like to thank Dr Martin Corley for introducing me to the LaTeX Typesetting System. Without this the thesis would have been far more difficult to write and would not have looked as professional.

I would like to thank my friends that have been with me throughout this. I have been lucky to have a great many friends who have helped me cope through the course of the thesis, but I am limited by space of how many I can thank specifically. I am grateful to Iain Burnside, Dr Claudia Coelho, Dr Ian Hume and Dr Ciarán O'Keeffe for all being there for morale-boosting chats throughout the

PhD process. A special mention has to go to Dr Jamie Heckert, who introduced me to the concept of a "big-picture attack" and reassured me that feeling as if you are going slightly mad is merely part of the process. I also appreciate him for acting as the "gate-keeper" between me and Paul when I was pestering him too much! One particular person I must thank has to be Marios Kittenis, my friend, office-mate and "EEG-Buddy". Of all of my friends, Marios knows better than most how difficult EEG methods are to use and I shall never forget staying in the lab until the early hours of the morning, soldering cables and trying to sort out problems. I owe him a great deal, and we were both there for one another during our respective PhDs. I especially want to thank Professor Robert Morris, to whom I have dedicated this thesis, for all of the help and support he provided while he was alive. Finally, there is my supervisor, Dr Paul Stevens, who means far more to me than just that. Paul and I were friends before I began my PhD, and he initially became my second, and then my primary supervisor after Bob's untimely death. Balancing a friendship, the shared editorship of the European Journal of Parapsychology, and supervisor/student relationship has had its problems, but somehow we have always managed to make it work. I really cannot thank Paul enough: quite simply without him I could not have done my PhD. I am truly honoured to be his first PhD student, and I could not have asked for a better supervisor or a more valued or loved friend.

Finally, I would like to thank my family, without whom I would be nothing. My grandfather, David Cormack, has always been there for me financially and emotionally, and although he may have not quite understood what my PhD is about, he has been constantly interested and supportive of it. My sister, Melissa Baker, not only lent me her brain for one of my experiments, but also gave me a much-needed shoulder to cry on when the going got tough. Finally, there are my parents, Elaine and John Baker. My mother taught me how to read, so in many respects this thesis is all her fault, my father had the confidence in me to provide for me financially at different times throughout the PhD, and both of them were convinced that I would successfully complete it. Without the love and support of my parents, I would never, ever, been able to do this.

Thank you all for your help

Dedication

This thesis is dedicated to Professor Robert L. Morris (1942–2004). Bob was my supervisor, my mentor and my friend. I called him when I was 15 years old in order to ask him how I could do a PhD, and he replied that I should "get some qualifications first." He was always there for me, and his dry wit and wise words always lessened any problem. I miss him so much.

I wish you were here to see this Chief!

Contents

List of Figures

List of Tables

Chapter 1

Introduction

This thesis is the first body of work to attempt to examine the potential electrocortical processing of remote staring detection. Remote staring detection has been defined anecdotally as the following:

> "Have you ever had the feeling that someone was staring at you from behind and, upon turning around, found you were correct?"
>
> (Braud, Shafer, & Andrews, 1993a, p. 373)

However, in experimental conditions this phenomenon has been operationally defined as:

> "...the purported ability to detect when one is being watched or stared at by someone situated beyond the range of the conventional senses."
>
> (Braud, Shafer, & Andrews, 1993b, p. 391)

It should be noted that within the context of remote staring detection, the term *staree* is used to refer to the person who is being stared at, and the term *starer* refers to the person who is doing the staring.

There has been considerable debate concerning the nomenclature and the definitions used in this area, and this is discussed in more detail in Chapter 2. This chapter also explores the beliefs and experiences associated with remote staring detection, and also reports the findings of a web-based study exploring these issues, which includes the largest and most international sample to date.

Chapter 3 follows on from this to outline the experimental research that has been conducted into remote staring detection. This body of research extends back over 100 years, and the chapter begins by describing the earliest, relatively sporadic pieces of research, followed by the influential introduction of electrodermal activity (EDA) measurement by Braud et al. (1993a, 1993b). The chapter then continues by exploring methodological issues surrounding the research into remote staring detection, including the criticisms of the use of EDA methods, the potential influence that experimenters might bring to the experiments, and how there has been considerable methodological divergence over the years concerning the most appropriate way to investigate the phenomenon.

Because this thesis represents the first attempt at studying the electrocortical processing of remote staring detection, Chapter 4 discusses the use of electroencephalography (EEG) and the most appropriate methods for analysing the complex data that is gathered from such a technique and also its potential importance for understanding the phenomenon.

Chapter 5 then outlines the potential connections between remote staring detection and more conventional forms of staring behaviour, including the social importance of staring, the impact of staring upon physiological arousal, and how faces and stares are processed in the brain, with a focus on the use of electrophysiological methods.

This then leads into the chapters reporting on the experimental work, where each experiment represents several experiments, and several measures, rolled into a single, large experiment. The first of these chapters, Chapter 6, reports on the initial experiment to examine the potential electrocortical processing of remote staring detection and its possible association with conventional face and staring processing.

These findings then led to the experiment reported in Chapter 7, which explored the possible relationship between face and staring processing with the processing of remote staring detection even further. This experiment also used a wider array of analysis methods, and the processing associated with the phenomenon was deconstructed in great detail.

The reversal of the effect from the experiments reported in Chapters 6 and 7 led to the experiment reported in Chapter 8, where the reversal was explored further and the extent to which the effects were due to remote staring detection was assessed in greater detail. Findings from this experiment and subsequent testing of the experimental set-up, which were beyond the normal types of system testing usually performed, led to the suggestion that the apparent 'remote staring effect' might be due to yet another, equally fascinating effect.

The chapters reporting on the experiments that were conducted to investigate the potential electrocortical processing of remote staring detection follow linearly from one to the other, with the findings from the previous study being instrumental to the development of the subsequent study. Therefore the interpretations from each experiment demonstrate a successive building of understanding as more evidence was discovered, and the findings from the latter experiments are not retroactively applied to the former experiments until the discussion of all of the findings of the thesis in Chapter 9. This chapter explores the findings of the thesis in terms of their potential implications for psychophysics and studies using event-related EEG methods, and for parapsychology and the study of remote staring detection.

Chapter 2

Remote Staring Detection: Definition and Belief

2.1 Defining remote staring

As described in Chapter 1, the operational definition of remote staring detection which will be used throughout this thesis is as follows:

> "... the purported ability to detect when one is being watched or stared at by someone situated beyond the range of the conventional senses."
>
> (Braud et al., 1993b, p. 391)

A number of different terms have been suggested to define the phenomenon that is referred to here as 'remote staring detection' (I. S. Baker, 2005). These include; 'remote staring' (e.g., Braud et al., 1993b), 'unseen gaze' (e.g., Braud et al., 1993a), 'unseen staring' (e.g., Colwell, Schröder, & Sladen, 2000), 'covert observation' (e.g., Schlitz & LaBerge, 1997), 'feeling stares of unseen others' (e.g., Cottrell, Winer, & Smith, 1996) and 'the feeling of being stared at' (e.g., Sheldrake, 2003). 'Remote staring detection' was chosen as the term used throughout this thesis to refer to this type of phenomenon, as it appears to be the most descriptive of the phenomenology, the most unambiguous, and the most widely used in the literature. Many of the other terms used have a number of problems associated with them which are outlined below.

Although the term 'the feeling of being stared at', initially appears to have the greatest ecological validity, I have previously argued (I. S. Baker, 2005) that there are significant problems with it as it is vague and ambiguous, and makes no distinction between the operationally defined 'paranormal' detection of a remote stare (i.e., that beyond the detection of the conventional senses) and the more conventional detection of a 'normal' stare. This would normally not represent a major problem due to the context of the majority of previous experimental remote staring research, but the material presented in this thesis brings together research into the detection of stares from areas of parapsychology and cognitive neuroscience, and the 'feeling of being stared at' is too generalised and can refer to mechanisms present in both areas of research.

As I have previously suggested (I. S. Baker, 2005), the term 'remote staring detection' not only uses the term 'remote' to highlight the potential 'paranormality' of this effect, but it also incorporates the important 'staring' element of social interaction. One of the issues with research into visual social interactions, particularly in social and cognitive research, is the use of term 'gaze' as a generic term for the multitude of different visual interactions. One of the leaders of the social psychology approach of research into non-verbal social interactions was Micheal Argyle, who attempted to remedy this situation by adding the term 'mutual gaze' (Argyle & Cook, 1976) to the more generic 'gaze'. This new term refers to, "...the percentage of time two interactors look at each other in the region of the face."(Argyle, 1988, p.153). However, Argyle and Cook's work has been criticised[1] for its lack of definition when referring to different types of visual social interaction;

> "Critical terms such as 'gaze', 'look', 'stare', 'gawk' and 'glance' are vague and unspecified. Sometimes these look-terms are interchanged although I suspect even common usage would distinguish among them."
>
> (Kirkland, 1976, p.371)

In order to investigate this, both Kirkland and Lewis (1976) and more recently myself (I. S. Baker, 2001) have examined participant's subjective judgements of the 'length of time of the eye-fixation' of certain descriptive terms used in non-verbal research, such as 'glance', 'look', 'gaze', 'watch', and 'stare'. With regard to the term 'remote staring detection', participants in both studies consistently rated a 'gaze' as being of a shorter duration than a 'stare'. A stare has been defined as being significantly different to a gaze, because a gaze is often part of a dyadic interaction, but a stare can be maintained invariant of

[1]Interestingly, when I contacted Professor Argyle about this matter, he was unaware of this criticism and of the commentary on the terminology used in this area (Argyle, 2001).

another person's behaviour. As Ellsworth, Carlsmith, and Henson (1972, p. 303) clearly define it, a stare is "... a gaze or a look that persists regardless of the behaviour of the other person." This is a fundamental issue in visual social interaction research as a failure to adequately describe the type(s) of interactions which are of interest to the researcher leads to ambiguity in understanding the data. This is also a problem with research in the cognitive and neuroscience literature, as researchers fail to acknowledge the distinctions in terminology and consistently use the term 'gaze' for virtually all research in this area, even though the empirical work often uses stimuli that involve participants being 'stared' at by images which are invariant upon the behaviour of the observer. This issue is also true of the remote staring detection literature, where there appears to have been no attempt at understanding the multitude of terms used for describing this phenomenon. The usage of 'staring' is useful, as it describes a behaviour which, although evidently artificial, is maintained invariant to the observed person's behaviour.

I have also argued (I. S. Baker, 2005) that 'detection' is also important when defining the phenomenon, as the experimental research examining remote staring detection is normally measuring behavioural or physiological variables from the staree in order to see if there is a significant change between non-staring and remote staring conditions, in a controlled environment. Anecdotal reports may also report this, but it is difficult to verify the experiences as there is no control over extraneous variables. Additionally, different methodologies can offer differing degrees of control in experimental situations, generally contrasted against different levels of ecological validity (see section 3.5.3 on page 52 for more details).

In a recent special issue on remote staring detection in the *Journal of Consciousness Studies*, Sheldrake (2005a) was heavily criticised by myself (I. S. Baker, 2005)[2], Blackmore (2005), Braud (2005) and Atkinson (2005) for use of the term "the sense of being stared at". In this issue, Carpenter (2005) suggested the use of the term *"scopaesthesia"* as an alternative. In reply, Sheldrake (2005c) passionately agreed with Carpenter (2005), citing that *scopaesthesia* takes its roots in the Greek verb *skopein*, to look at, and *aesthesis*, sensation, and adopted the use of this term throughout the rest of his paper (p. 118). However, the adoption of this term does not, in any way, help to clarify the definition of the phenomenon. The term scopaesthesia merely translates, in essence, as "the sense

[2]A copy of my (I. S. Baker, 2005) commentary on Sheldrake's work is included in Appendix A starting on page 245.

of being stared at" in English! Translating a term that has been criticised as being vague and inaccurate into another language does not add anything to its validity. It is a vain attempt at translating this term into Latin or Greek in an effort to provide it with an associated legitimacy, thanks to the use of such ancient languages in medical and scientific literature. It is completely unwarranted in this case, and does not clarify the definition — if anything, it adds another layer of impenetrability.

In summary, regardless of its potential limitations, the term 'remote staring detection' appears to be the most accurate description of the phenomena as it is presently understood, as well as containing elements of one of the most common terms used in the literature.

2.2 Belief in remote staring detection

There have been several surveys examining incidences of belief in remote staring detection. The first survey was conducted by Coover (1913), who asked 146 students attending a General Psychology course at Stanford University if they have had "...the feeling of being stared at, with the conviction that the feeling can be (more or less) relied upon." (p. 571). He found that 68% of the students said that they did. In order to examine if this class was exceptional in their belief, he also asked 102 students in another psychology class (Mental Hygiene) if they have had this experience, and 86% said that they had. However, Coover's (1913) question fails to adequately distinguish between the *experience* and the *belief* of being stared at remotely.

Schlitz and LaBerge (1997) report that Williams (1983) conducted a survey of an Australian population and discovered that 74% of respondents had reported a remote staring experience. However, Williams (1983) does not report these details in her paper, and Schlitz and LaBerge (1997) unfortunately do not provide any further information about the nature of the survey.

The next report of an examination of belief in remote staring detection was a brief description of an informal study mentioned at the beginning of Braud et al.'s (1993a) paper, where it was reported that 94% of San Antonio (USA) respondants had said that they had had this experience. However, they fail to provide any details of the survey, particularly the basics such as the number of respondants, and the exact details of the question asked. Although the implication is that the question was concerning experience, it may have been about belief.

G. T. Rosenthal, Soper, and Tabony (1994) report that in a survey of the beliefs of 75 college students, 87% agreed with the statement "A person can sense he is being watched, when the watcher is hidden" (as reported by G. T. Rosenthal, Tabony, Soper, & Rosenthal, 1997, p. 75). However, there are few details of the study, and there appears to be no awareness on behalf of the authors of the parapsychological literature on this phenomenon.

As reported by Sheldrake (1994), a series of informal surveys conducted by him in Europe and America suggested that 80% of people have claimed to have experienced "the sense of being stared at", but he also fails to report basic details of the surveys. This is further compounded by the ambigous nature of the term "the sense of being stared at", which as was argued in the last section, has been criticised for not neccessarily suggesting a remote or 'paranormal' element. Therefore it is unclear if respondants understood the question in terms of remote staring detection, or as more conventional forms of social interaction (see also I. S. Baker, 2005).

All of the above studies can be criticised for being very basic and for failing to adequately divide the elements of the belief in, and the experience of, remote staring detection. They also fail to distinguish between the experience as the role of the starer (i.e., staring at someone remotely and watching them turn around), and the role of the staree (i.e., feeling the remote stare of another and turning around). However, in a study that both Braud et al. (1993a) and Sheldrake (1994) fail to reference, Thalbourne and Evans (1992) did examine elements of belief and experience in a more robust manner. Thalbourne and Evans (1992) asked 59 students at Washington University, who were on an introductory course in parapsychology, a series of 10 true/false questions on the power of gaze, of which four had an overtly 'paranormal' component (each question is followed by the percentage of respondents who replied 'true'):

1. I believe that there are some people who possess an 'evil eye' — that is, a gaze that can inflict harm or bring about bad luck (19%).
2. I believe that there are some people who possess a 'magnetic gaze' — that is, they are able to make other turn toward them just by looking at them (76%).
3. Sometimes I can make someone turn towards me just by looking at them (66%).
4. Sometimes, I have sensed that I was being watched or stared at by someone even though they were situated a considerable distance behind me (85%).

The last two questions are of particular interest, as they suggest that there are different degrees of experience of remote staring detection depending upon whether the experient is reporting as having acted as a starer or a staree.

A more in-depth analysis of belief in remote staring detection was conducted by Cottrell et al. (1996). Although elements of their study shared similarities with the studies above, the basic premise of their research was considerably different. They were attempting to examine remote staring detection (they did not use this term) belief and its association with belief in extramission and the use of irrational thinking. Extramission essentially refers to the concept that "vision involve[s] emissions from the eye" (Cottrell et al., 1996, p. 50).

Cottrell et al. (1996) report three studies; the first study involved asking 68 11–12 year olds, and 67 college students two different questions: (a) "Do you ever feel that someone is staring at you without actually seeing them look at you?", and (b) "Do you think that other people can feel (without seeing) when someone is looking at them?" (p. 53). They found that approximately 92% of the children and 87% of the adults answered "rarely, sometimes or often" to the first question, and approximately 90% of the children and 88% of the adults answered in these three categories to the second question. As they found no significant age differences in belief, Cottrell et al. (1996) found it difficult to reconcile this finding with their hypothesis that logical thinking increases with age. However, they also asked both groups about their extramission beliefs, and found a significant decline in the belief that 'rays' (or similar) go out of the eyes during the process of vision, with 49% of the children believing in this, compared to 16% of the adult sample.

In their second study, Cottrell et al. (1996) examined belief in remote staring detection in more detail, specifically the effects of occlusion (i.e., the presence of a curtain or mirror between the starer and staree), as they theorised that if extramission belief is related to remote staring belief, then the presence of obstacles between the starer and staree would interfere with the 'rays' coming from the starer's eyes. They also examined the belief concerning cases when the starer was staring, but not thinking about the staree, and the alternative where the 'starer' is thinking about, but not staring at, the staree. They questioned 66 11–12 year olds and 115 college students, and found an overall effect of occlusion in the following order (increasing order in the feeling of stares): one-way mirror, dropped screen, peep-hole, transparent curtain, window. However, as Cottrell et al. (1996) point out, the order suggests that the obstacles between the starer and staree are not interpreted in terms of occlusion, as the 'peep-hole' is rated low, but it would not interfere with extramission. This provides further evidence to suggest that neither age-group interprets the feeling of being stared at in terms of extramission belief, although children were more likely to believe in remote staring detection than adults in this study. Cottrell et al. (1996) also found that both age-groups believe significantly less in the concept that people can detect when another person is thinking about them but not watching them, compared to remote staring detection, from which Cottrell et al. (1996) suggest that "...participants differentiated the phenomenon of felt stares from something akin to extrasensory perception." (p. 55). However, this finding could be an artefact of this question being associated with other remote staring questions that prime the participants into thinking in terms of remote staring and prevent them from considering the phenomenon within the framework of ESP. The only way that Cottrell et al. (1996) could have verified this finding would be to have asked participants how they think that remote staring could work, something that they failed to do. If Cottrell et al. (1996) had paid more attention to the parapsychological literature, they may have found more evidence to suggest lines of enquiry to examine the beliefs of the potential mechanisms of remote staring detection that do not involve a reliance on extramission belief. Although they report a correlation between belief in remote staring detection and extramission belief in this study, they fail to provide evidence for a direct causal link between the two belief structures.

In the final study reported in their paper, Cottrell et al. (1996) asked questions about remote staring and extramission belief in an face-to-face interview format to four different age-groups: seven year olds (41 of them), nine year olds (40), 11 year olds (49), and college students (58). They found a significant age trend difference in belief in remote staring detection, with belief *increasing* with age, which was backed-up by M. C. Smith's (1993) study (reported in Cottrell et al., 1996, although without details) that 97% of surveyed college students believed in remote staring detection. In contrast, they found the reverse effect with extramission belief, in that it *declines* with age. In light of the findings from all three studies, they conclude that "...the different developmental trejectories of these two belief systems suggest that they represent different belief systems." (Cottrell et al., 1996, p. 58).

There are a number of issues that surround Cottrell et al.'s (1996) work. Apart from their lack of awareness of the parapsychological literature, their questions fail to explicitly ask if the people actually *believed* in the phenomena that they were interested in, with the questions focussing on experience instead.

Although Cottrell et al. (1996) did do some pilot work to verify that there were no significant effects of this wording, it is difficult to ensure that their findings are not due to participants responding to their experiences, and not their beliefs. Cottrell et al. (1996) also initially stress the point that belief in remote staring detection and extramission are related, and that belief in these phenomena are related to irrational thought which should decrease with age. However, they were later surprised to find that they actually represent two different belief systems, and that belief in remote staring detection actually *increases* with age. But these findings are not necessarily so surprising. Respondents in Cottrell et al.'s (1996) study could have been basing their responses on everyday experiences that could have had conventional explanations. It is easy to misrepresent experiences of everyday remote staring detection in terms of several factors, including activity in the areas of peripheral vision, selectively attending to a person looking at you under certain circumstances, and selectively recalling times when you look around to find another person looking at you, and forgetting about instances when you turn around to find no one looking at you. It is difficult to verify such experiences. Cottrell et al. (1996) are also associating both belief in remote staring detection and extramission with irrational reasoning. Although extramission belief might be irrational, Cottrell et al. (1996) fail to uncover whether respondents directly believe that the extramission process explains the remote staring detection effect, and their findings suggest that they actually represent two different belief systems. In fact, they move away from associating extramission with belief in remote staring detection in their subsequent work (i.e., Winer, Cottrell, Karefilaki, & Chronister, 1996; Winer, Cottrell, Karefilaki, & Gregg, 1996b; Gregg, Winer, Cottrell, Hedman, & Fournier, 2001; Winer, Cottrell, Gregg, Fournier, & Bica, 2002; Bahr, 2003; Robbins, 2003; Winer, Cottrell, Gregg, Fournier, & Bica, 2003). Belief in remote staring detection might not be irrational, because participants are basing their responses on their own experiences which may have had a conventional cause but interpreted in terms of remote staring detection. Additionally, if Cottrell et al. (1996) had shown more awareness of the empirical evidence of remote staring detection ability under controlled conditions, they may have found that there is a greater degree of evidence supporting the validity of remote staring detection than their review of only Titchener (1898) and Coover (1913) would suggest. However, for all of the potential flaws of Cottrell et al.'s (1996) research, they did provide some of the most informative evidence of belief in remote staring detection, and that it would appear to be considerably different to belief in extramission.

This paper was then followed by Radin's (1997) assertion that "...contemporary opinion polls consistently confirm that the feeling of being stared at is known in all cultures". Unfortunately, he failed to verify this sweeping statement with any empirical data or references.

The most recent study into belief in remote staring detection was reported by Sheldrake (2003). In this study, 320 people (175 female, 154 male) from a variety of locations in Britain, Sweden and the USA were asked to respond "Yes or No" to the following question: "Have you ever felt that someone was looking at you from behind, and turned around to find that they were? (Exclude experiences that could have an ordinary explanation)." (Sheldrake, 2003, p. 316). A total of 81% of the women and 74% of the men replied "Yes", and Sheldrake (2003) also examined the frequency of the experience, the relationships of the people involved, and if this could also occur with animals. However, there are some issues with this survey. Firstly, respondents were people who had attended one of Sheldrake's lectures, and were therefore likely to have attended because they were interested in, or had experienced, this type of phenomenon. Also, because he administered the questionnaire after the lecture, the respondants had just been exposed to material concerning the validity of remote staring detection, and were therefore likely to have been even more biased. Additionally, although Sheldrake (2003) makes a valiant attempt at excluding experiences that may have an conventional explanation, this exclusion is reliant upon the experient's belief that there could be no conventional explainations of their experience.

Although more detailed work is needed, the studies above suggest that belief in remote staring detection, regardless of its potential explanation, is widespread and is usually highly prevalent in the samples measured. This strongly supports the claim that this phenomenon should be investigated under controlled laboratory conditions, as it represents an integral belief structure for so many people.

2.3 Web survey into remote staring detection belief and experience

2.3.1 Introduction

As can be seen from the studies covered in section 2.2, belief in remote staring detection is widespread, but there has been only a handful of studies that have attempted to assess the relationship between belief and experience in remote staring detection, and the specific nature of these two elements.

In the following study, these components were analysed using an international population larger than any previous survey into beliefs and experiences of remote staring detection, thanks to the availability of respondents from the World Wide Web. Studies of this type do have their limitations. For example, the sample is largely self-selected, and therefore it is difficult to provide an accurate index of belief that relates to a wider population. However, such methods also provide increased generalisability through international samples with a far wider distribution of demographic characteristics. Additionally, as participants complete the survey at their leisure and in their own environment, these methods have a higher degree of ecological validity (Reips, 2002). Although it is difficult to provide an index of belief, such a sample can be used to understand the relationships between different experiences and beliefs.

This study examined the two main elements of the experience of remote staring detection; acting as the 'starer', and acting as the 'staree', in a similar manner to how Thalbourne and Evans (1992) examined these experiences. Similarly, a general question on belief in the 'evil eye' was also asked. This belief centres around negative influences associated with one person staring at another person, and is particularly associated with the expression of envy (Maloney, 1976; Dundes, 1992). The believed effect on the individual to which the evil eye is directed can be extreme, including impotence, disease, and even death (Reminick, 1985). Several researchers have associated belief in the evil eye as being the same as belief in remote staring detection (e.g., Thalbourne & Evans, 1992; Sheldrake, 1994; Cottrell et al., 1996; R. A. Baker, 2000; Sheldrake, 2003), but this relationship has not been explicitly demonstrated and is therefore examined in more detail in this survey.

Also examined in this study was the impact on belief in remote staring detection with the addition of obstacles between the starer and the staree. This is similar in some respects to the questions asked in Cottrell et al.'s (1996) study, but without the underlying premise that there is an association between remote staring detection and extramission, and that occlusion impacts upon the transmission of the remote stare. Instead, these questions were focussing on belief in remote staring detection and its relationship to the different types of experimental methodology that have been employed in its measurement (highlighted in I. S. Baker, 2005). These methods have generally included experiments where the starer and staree have been in the *same room* (e.g., Coover, 1913; Sheldrake, 2005a), separated by a *window* (e.g., Sheldrake, 2000), separated by a *one-way mirror* (e.g., Peterson, 1978), and separated by a *CCTV system* (e.g., Williams, 1983; Braud et al., 1993a, 1993b). It is theorised that there will be a significant linear decrease in belief with the increase of the degree of obstacles between the starer and staree. This change in belief in the possibility of remote staring detection between the different experimental methodologies could have a large impact on the perceptions of participants on the possibility of success of a particular experiment, and could be an important factor for how participants are recruited.

Finally, the relationship between experience and belief in remote staring detection will be examined. Based on Cottrell et al.'s (1996) work, particularly the gender effects that they note in the second study they report in their paper, it is theorised that females are more likely to believe in and experience remote staring detection than males. An exploratory part of this comparison is to examine if females correlate with acting as the role of the staree differently to acting as the role of the starer, as Cottrell et al. (1996) do not examine this distinction.

2.3.2 Method

2.3.2.1 Participants

588 self-selected and unpaid participants completed the on-line questionnaire from 5th September 2005 to 20th November 2005. Participants were primarily recruited via links from the websites of both the University of Edinburgh's Psychology Department and the Koestler Parapsychology Unit.[3] Data from 64 (11%) participants were removed from the sample due to missing values for the main measures (this did not include missing data for the questions of nationality, gender or age). The data from a total of 524 participants was used in the analysis, consisting of 173 males and 331 females (20 unspecified), aged from 13 to 87 years old (Mean = 32.5 years). The participants came from a total of 43 different self-specified nationalities[4], and the breakdown of the majority of

[3]It should also be noted that the questionnaire quickly became the top result for searches for both *remote staring* and *remote staring detection* on http://www.google.com, and therefore participants could have been recruited from elsewhere once the link to the questionnaire was in the public domain.

[4]These nationalities were as follows: American, Australian, Belgian, Brazilian, British, Bulgarian, Canadian, Chinese, Costa Rican, Croatian, Dutch, English, Finnish, French, German, Greek, Hungarian, Icelandic, Indian, Irish, Italian, Japanese, Malyasian, Mexican, New Zealander, Nicaraguan, Norwegian, Pakastani, Peruvian, Polish, Portuguese, Puerto Rican, Russian, Scottish, Serbian, Slovakian, Spanish, Swedish, Swiss, Taiwanese, Turkish, and Welsh. Approximately 13% of respondants did not provide details of their nationality.

the nationalities is shown in figure 2.1 on page 15. This study received ethical approval from the Ethics Committee of the School of Philosophy, Psychology and Language Sciences at the University of Edinburgh.

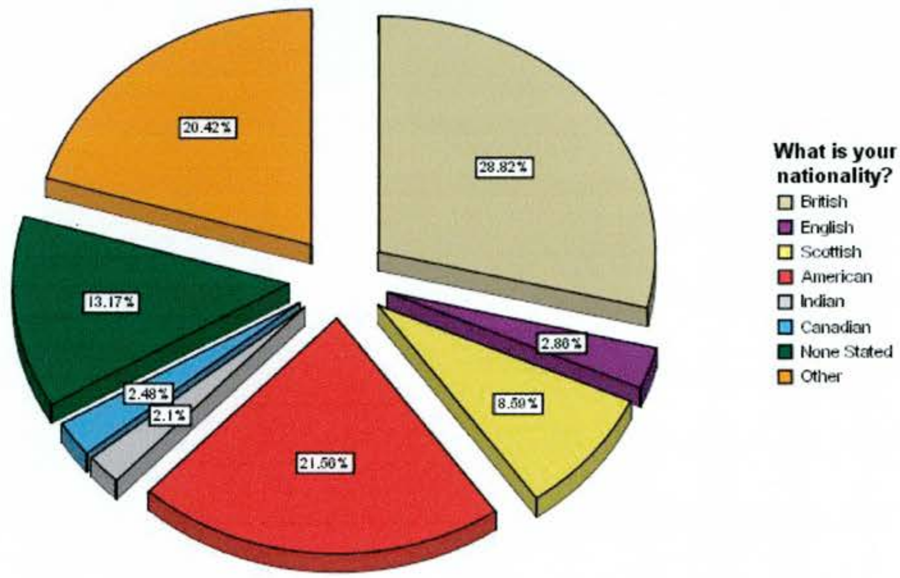

Figure 2.1: Diagram of the nationalities of the survey participants (Top 98% of nationalities)

2.3.2.2 Materials & Procedure

The survey was divided into five separate web-pages using the SurveyMonkey website[5]; the first introduced the questionnaire and provided instructions for its completion, the second provided the main survey questions on the experience of remote staring detection, the third provided the main survey questions on the belief in remote staring detection, the fourth asked three demographic questions (What is your gender/nationality/age?), and the fifth provided a debriefing to the participants and further contact details of the experimenter.

The first web-page introduced the questionnaire in an informal manner with the following information:

> "This questionnaire is examining the belief in and experience of 'remote staring detection'. This has been defined as '... [having

[5]The link to the survey was http://www.surveymonkey.com/s.asp?u=409081062693

> the] feeling that someone was staring at you from behind and, upon turning around, [finding out that] you were correct.' (Braud, Shafer & Andrews, 1993). I am conducting this research as part of my PhD, which is the first ever PhD to examine this phenomenon.
>
> Please try to rate the statements on the following pages as honestly as possible. It should only take you a couple of minutes to complete this questionnaire. Please answer all of the questions.
>
> All of your answers will be held in strict confidence and are anonymous. If you would like to stop at any time, please feel free to do so. If you would like your data removed from the study and destroyed, please e-mail me at parapsychologist@gmail.com.
>
> This study conforms to the British Psychological Society Ethics Guidelines.
>
> Please only complete this questionnaire once. It would be great if you found that you enjoyed filling it in so much that you would like to do it again, but two sets of data from the same person could screw up the study. Thanks!"

The second web-page asked the main survey questions on the *experience* of remote staring detection, which were as follows (presented in this order):

1. How often have you felt the sensation that someone was staring at the back of your head, and when you have turned around, you have found someone staring at you?

2. How often have you stared at the back of someone's head, and they have turned around and looked at you?

These questions were measured on a 5-point Likert scale (1 = Never, 2 = Once or twice, 3 = Occasionally, 4 = Regularly, 5 = All the time).

The third web-page asked the main survey questions on the *belief* in remote staring detection, which were as follows (presented in this order):

1. I believe that you can detect another person's gaze from across a room, even if you cannot see them.

2. I believe that you can detect another person's gaze when they are looking at you through a window, even if you cannot see them.

3. I believe that you can detect another person's gaze through a one-way mirror (i.e., they can see you, but you cannot see them).

4. I believe that you can detect another person's gaze when they are staring at you via a closed-circuit television camera (CCTV).

5. I believe in the idea of an 'evil eye' (i.e., one person can cause harm to another person just by looking at them).

These questions were also measured on a 5-point Likert scale (1 = No, not at all, through to 5 = Yes, definitely). This was followed by a fourth web-page that asked general demographic information on gender, nationality and age.

The final web-page contained debriefing information as follows:

> "I really appreciate you taking the time to complete this questionnaire. If you would like to know the results from this study, or if you have any comments, queries or problems, please e-mail me at parapsychologist@gmail.com. You can read more about my research at my website [link to my website at the Psychology Department]. Thanks again! Ian Baker."

2.3.2.3 Hypotheses

There were several hypotheses for this study:

1. There will be significant positive correlations between the belief and experience questions.

2. There will be a significant difference between the two experience questions, as the experience of as acting as a starer might be different to the experience of being a staree.

3. There will be a significant difference between remote staring detection belief[6], and belief in the evil eye.

4. There will be a significant linear decrease in belief in remote staring detection in direct relationship with the increase in the number of obstacles that are placed in the path of the remote starer and staree.

5. Females are significantly more likely to believe in and experience remote staring detection than males.

[6] As measured by the question "I believe that you can detect another person's gaze from across a room, even if you cannot see them", as this is the most representative index of direct remote staring detection.

2.3.3 Results

The analysis was conducted using SPSS 12 and StatXact 7. Non-parametric statistics were used due to the significant non-normal distributions of the responses to each of the questions (as estimated using Shapiro-Wilk tests). All of the statistics were corrected for multiple comparisons using the Bonferroni correction for familywise error (FWE) presented below:

$$\alpha_B = \frac{\alpha_{FWE}}{c} \tag{2.1}$$

Where α_B is the new alpha level based on the Bonferroni test, α_{FWE} is the familywise error rate, and c is the number of comparisons (there are further details on the nature of this correction procedure in section 6.4.2.1 on page 124). The resulted in a highly conservative modified α level of .001 for the different analyses. However, the clearly significant nature of most of the comparisons in the analyses presented below made this correction largely redundant.

The descriptive statistics demonstrating how the participants responded to each of the questions is shown in table 2.1 on page 19, and is included here in order to provide greater detail on the nature of the sample's responses. As noted in the description of the table, this data should be treated with caution as the participants were recruited using a self-selected sampling method.

There were significant correlations between all of the belief and experience questions, as summarised in table 2.2 on page 20. However, these correlations were only demonstrating part of the relationship between these different measures, and further analysis was conducted in order to explore the effects of the study.

In addition to the correlations above, there were also significant correlations for gender for when an individual is acting as a staree (one-tailed Spearman's $r = .145$, $p = .001$), and for belief in remote staring detection across a room ($r = .152$, $p < .001$), suggesting that females have both felt a remote stare and believe in remote staring detection in the same room, significantly more than males. There was also a similar correlation for belief in the evil eye ($r = .107$, $p = .008$). Although this is technically not significant due to the modified α level, due to the high level of significance and the high N value of the comparisons, as well as the arguments of alpha correction resulting in the increased likelihood of committing a Type II error (see section 6.4.2.1 on page 124), it strongly suggests that this correlation should be regarded as significant.

A Wilcoxon Signed Ranks analysis comparing the two experience questions

		Response Scale										
		1		2		3		4		5		Mean
		No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	Response
Experience	Staree	32	(6.1)	95	(18.1)	260	(49.6)	112	(21.4)	25	(4.8)	3.01
Questions[a]	Starer	35	(6.7)	113	(21.6)	245	(46.8)	114	(21.7)	17	(3.2)	2.93
	Room	39	(7.4)	81	(15.5)	119	(22.7)	151	(28.8)	134	(25.6)	3.50
Belief	Window	58	(11.1)	108	(20.6)	128	(24.4)	143	(27.3)	87	(16.6)	3.18
Questions[b]	One-way Mirror	94	(17.9)	136	(26.0)	116	(22.1)	109	(20.8)	69	(13.2)	2.85
	CCTV	192	(36.6)	158	(30.2)	98	(18.7)	48	(9.2)	28	(5.3)	2.16
	Evil eye	267	(50.9)	106	(20.2)	71	(13.6)	43	(8.2)	37	(7.1)	2.00

[a]The five-point Likert scale for these responses was as follows: 1 = Never, 2 = Once or twice, 3 = Occasionally, 4 = Regularly, 5 = All the time.

[b]The five-point Likert scale for these responses was as follows: 1 = No, not at all, through to 5 = Yes, definitely.

Table 2.1: Frequencies, percentages and means describing how the 524 participants responded to the belief and experience questions on the corresponding five-point Likert scales. These descriptives statistics should be treated with caution due to the self-selected sampling method used.

	Experience Questions		*Belief Questions*				
	Acting as a Staree[a]	Acting as a Starer[b]	Room	Window	One-way Mirror	CCTV	Evil eye
Staree	—	—	—	—	—	—	—
Starer	.475	—	—	—	—	—	—
Room	.462	.361	—	—	—	—	—
Window	.419	.374	.773	—	—	—	—
One-way Mirror	.356	.340	.664	.763	—	—	—
CCTV	.313	.244	.504	.588	.657	—	—
Evil eye	.305	.244	.371	.391	.424	.476	—

[a]i.e., "How often have you felt the sensation that someone was staring at the back of your head, and when you have turned around, you have found someone staring at you?"

[b]i.e., "How often have you stared at the back of someone's head, and they have turned around and looked at you?"

Table 2.2: Two-tailed Spearman correlations of the remote staring detection experience and belief questions ($N = 524$, all values of r significant to $p < .001$)

did not find a significant difference between their ranks ($T = -1.779$, $p = .076$). Along with the significant correlation, it suggests that there are no significant differences between these two questions.

Although there was a significant correlation between questions "I believe that you can detect another person's gaze from across a room, even if you cannot see them", and "I believe in the idea of an 'evil eye' (i.e., one person can cause harm to another person just by looking at them)", a Wilcoxon Signed Ranks analysis found a significant difference between them ($T = 16.530$, $p < .001$).

A Page's L test for trend suggested that there was a highly significant linear relationship between the ratings for the different types of remote staring detection ($L = -22.23$, $p < .00001$)[7]. This suggests a linear decrease in belief with the increase of the degree obstacles that are placed in the path of the remote stare, from the same room, to through a window, through a one-way mirror and finally via a CCTV system. This linear relationship is clearly demonstrated in figure 2.2.

2.3.4 Discussion

The results suggest that belief and experience of remote staring detection are highly correlated, but the results also suggest a more complex relationship than this. Firstly, there do not appear to be significant differences between the starer and staree elements of experience, which suggests that respondents do not view them as significantly different or separate phenomena, but rather elements of the same phenomena. There is also an interesting and significant gender effect, where females are more likely to believe in remote staring detection in the same room than males. Females also report significantly more experiences as a staree than males, and are more likely to believe in the evil eye. This is similar to the effect noted by Cottrell et al. (1996), and they interpreted it in terms of females being more sensitive to gaze or stares, summarised neatly by Argyle and Cook (1976) in their seminal work *"Gaze and Mutual Gaze"*, where they comment that "...females look more than males, on all measures of gaze." (p. 147). However, this might not be due to a greater degree of refinement on behalf of females in interpreting staring or gaze, but due to a different type of importance placed upon such interactions, as "for a female to be looked at by a male often indicates sexual choice..." (Argyle & Cook, 1976), and Argyle and Williams (1969) noted that in mixed sex interactions, females often reported feeling more 'observed'. It is

[7] A *Monte-Carlo* analysis of this data (1×10^8 randomised samples) produced the same test statistic result.

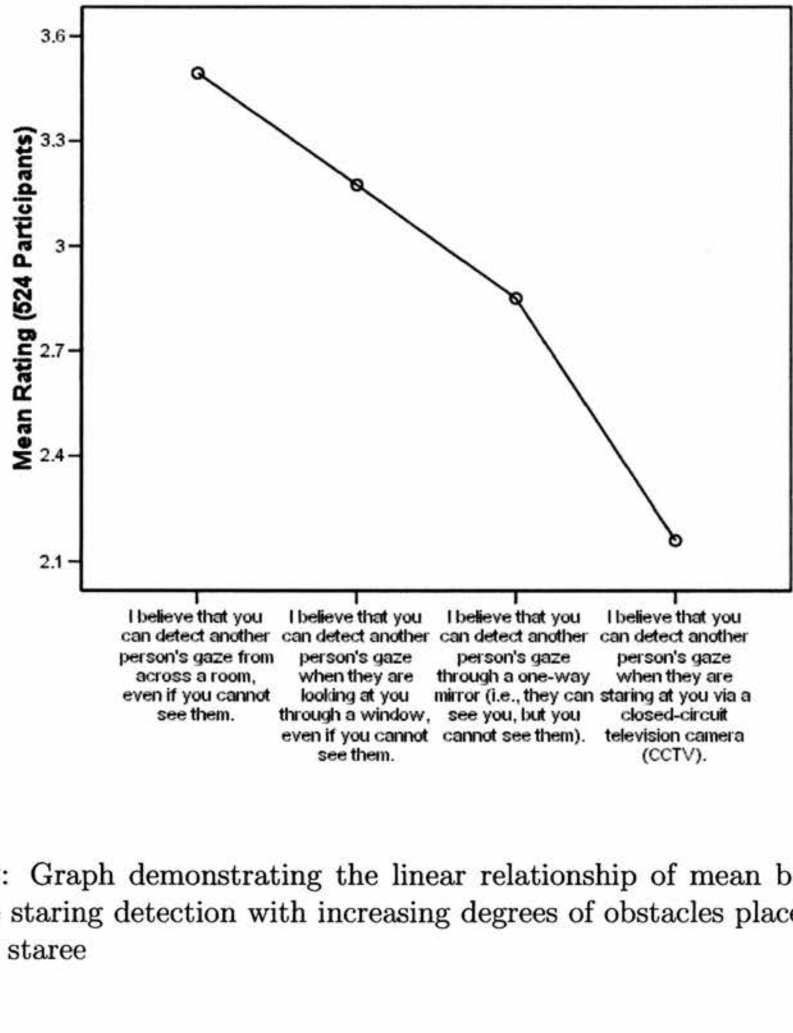

Figure 2.2: Graph demonstrating the linear relationship of mean belief scores for remote staring detection with increasing degrees of obstacles placed between starer and staree

unclear if this finding is due to conventional eye-based social interactions, or if it is specifically related to remote staring detection, and females are more sensitive to this than males. Future experimental work could concentrate on conducting comparative experiments examining the effects of male and female starers on staree's of the same and opposite sex. Such experiments would be logistically difficult, but may go some way in potentially explaining the experimenter effect reported by Wiseman and Schlitz (1997, 1999), which is explored in more detail in section 3.5.2 on page 46, as Wiseman is male and Schlitz is female. However, this is further confounded by the possibilities that the starer might be 'bad' at staring, or that the experimenter is having a detrimental effect on the experiment. Schlitz, Wiseman, Watt, and Radin (in press) attempted to address the latter of these issues in a recent paper, but the findings were unfortunately inconclusive.

Although they are correlated, there are also significant differences between the ratings of belief in remote staring detection, and the belief in the evil-eye. Although these measures of these complex belief structures are quite crude, this result does suggest that respondents do not necessarily believe that these two types of phenomena are equivalent. This is an important finding for evaluating remote staring detection research, as several researchers have associated belief in remote staring detection and belief in the evil eye as representing belief in the same phenomenon (e.g., Thalbourne & Evans, 1992; Sheldrake, 1994; Cottrell et al., 1996; Radin, 1997; R. A. Baker, 2000; Sheldrake, 2003). However, this finding suggests that people may view these as two different types of phenomena, and should therefore be studied separately and not assumed as being equivalent. Obviously, there is more research needed to examine the differences in belief between these phenomena. For example, there could be a response bias in the data as the concept of the 'evil eye' has negative connotations that are not necessarily associated with the more neutral concept of remote staring detection. Also, belief in the 'evil eye' could be part of a wider and more complex belief system that is not necessarily shared by the sample measured by this study, and a more in-depth anthropological study comparing evil eye belief and possible relationships with remote staring detection might be more appropriate.

The results also suggest that there is a highly significant linear trend in the belief in remote staring detection, with belief in remote staring detection decreasing with the more obstacles that are placed between the starer and the staree. This is important because it suggests that individuals are less likely to believe in the possibility of remote staring detection if more barriers are introduced. This has a potential impact for participants of remote staring detection studies if they are recruited on the basis of a general description of 'remote staring', which they may assume is in the same room, but the experiment employs controls which separate the starer and staree, such as the use of CCTV systems. This difference in belief also supports the claim suggested by myself (I. S. Baker, 2005) that the experiments into remote staring detection where individuals are in the same room should be considered as being different to experiments that employ CCTV-based methods.

2.4 Conclusions

As can be seen, there are several important issues surrounding the nomenclature used in this area, and although the term is not perfect, "remote staring detection" appears to be the most accurate and currently seems to be a meaningful way of describing the phenomenon.

It is also apparent that there are many problems with the previous research examining beliefs and experiences surrounding remote staring detection, mainly because the questions exploring these issues are generally limited to only certain aspects of the phenomenon. However, the web survey reported here appears to have cast new light upon some of these issues and revealed some of the complexity surrounding how people perceive the phenomenon of remote staring detection. Future work can build upon these findings to attempt to deconstruct these beliefs and experiences further, and see what other psychological variables are related to them.

The survey results also serve to highlight how some people have experienced remote staring detection in everyday life and are prepared to believe in it. This has led to controlled experimental research in order to empirically explore this potential phenomenon in more detail. This experimental work is summarised and critiqued in the next chapter.

Chapter 3

Experimental Research into Remote Staring Detection

3.1 Introduction

Experimental research into remote staring detection is often categorised within an area of parapsychology referred to as *Direct Mental Interaction between Living Systems*, or DMILS, even though the first experiments into remote staring detection considerably pre-date the use of this term (e.g., Titchener, 1898). Based upon Braud's (1993) general definition, a typical DMILS experiment has several main characteristics, primarily involving the use of a living *target* organism that is isolated from all conventional interaction with the *influencer*, which is an individual that mentally attempts to actively alter a predefined aspect of the target organism's biological activity on a randomised schedule.

Braud (1993) argues that this type of research has a long history, dating from Mesmer's work on Mesmerism and animal magnetism from 1775, through to Vasiliev's (1963/2002) research, and Braud's own research which has been dominant in this area (see below). Braud (1993) also summarises the plethora of terms that have been used in this area, from "telepathy at a distance", to "living target psychokinesis", to Stanford's (1974) "mental or behavioural influence of an agent (MOBIA)", to Braud's (1978) "allobiofeedback", to Braud and Schlitz's (1983) "Bio-PK", to the term he suggests "distant mental influence", which gradually became DMILS (Braud, 2003).

Braud and Schlitz (1991) published an extensive summary of 13 years of their research into this area, discussing studies that utilised dependent variables as wide-ranging as the effects on the target's blood pressure, muscular activity, the locomotor activity of small mammals, and the hemolysis of human red blood cells, with the suggestion that these effects were "...relevant to our understanding of processes underlying certain forms of unorthodox healing (i.e., mental, spiritual, or absent healing)..."(Braud & Schlitz, 1991, p. 3), with much of this material being brought together in Braud's (2003) more recent publication. However, the dominant measure has been to examine the impact on the electrodermal activity of humans, and Schlitz and Braud (1997) published a meta-analysis of two types of studies that implemented this method in different ways. The first type were the *distant intentionality* studies, where the influencer attempted to "activate" or "calm" the target's EDA during experimental periods, and not to think of the target during the "control" periods, and the second type were the *remote staring detection* studies, which are the focus of this chapter. Schlitz and Braud's (1997) analysis suggested a small, but highly significant, effect for both the distant intentionality studies ($r = .25$, $p = .0000007$), and the remote staring detection studies ($r = .25$, $p = .000054$). An arguably more stringent meta-analysis recently published by Schmidt, Schneider, Utts, and Walach (2004) also suggested that there was a small, but less significant effect, for both classes of study ($d = .11$, $p = .001$, and $d = .13$, $p = .01$ for the two groups respectively).

As can be seen, research into remote staring detection can be viewed as an integral part of DMILS research, which is important to the validity of the area and indeed to parapsychology as a whole. However, it has also had a long and varied historical development as an independent area in its own right. This chapter will be summarising the experimental research into remote staring detection and presenting the major findings, including the methodological development and issues surrounding the research, and highlighting some of the main issues, controversies and problems with the previous research, and some of the ways in which these can be overcome.

3.2 Early research

The earliest study into remote staring was conducted by E. B. Titchener in 1898, and it provides a fascinating glimpse into the mind of the earliest researcher of this topic. As he uses phrases such as, "...no scientifically-minded psychologist believes in telepathy ..." (Titchener, 1898, p. 897), it is easy to see his view of the research he is engaging in, and no doubt he would be horrified now to learn of the modest amount of contemporary research into remote staring that his original research helped to create. Titchener states that he became interested in this phenomenon after hearing, each year, a consistent number of his students refer to it. His description of the phenomenon, which later became known as remote staring detection, represents the first attempt to define it in the literature:

> "The 'feeling' when it is not merely described as 'uncanny,' 'a feeling of Must,' etc., is referred to as a state of unpleasant tension or stiffness at the nape of the neck, sometimes accompanied by tingling, which gathers in volume and intensity until a movement which shall relieve it becomes inevitable. It is believed that this stiffness is, in some way or other, the direct effect of the focussing of vision upon the back of the head and neck."
>
> (Titchener, 1898, p. 895)

Titchener reports that he conducted, at different times, a series of laboratory experiments investigating this phenomena with students who claimed to have experienced it, either as a starer or as a staree. He reports that he obtained negative results, which supported his self-reported aims to break down belief in this superstition and set students "... upon the straight scientific path."(Titchener, 1898, p. 895). In Titchener's view, this remote staring detection is caused by a four-step psychological process, which is summarised as follows: (a) he suggests that we are constantly nervous about having our backs exposed, mainly due to "... the constant care that must have been devoted to the defenseless back when our ancestors first assumed the upright position."(Titchener, 1898, p. 896), (b) the presence of people behind a person prompts a natural inclination to turn the head to see what is going on. This is followed by (c) we rapidly attend to movement, and therefore our gaze is attracted to a person whose head appears to be looking around in our general direction, and finally, (d) the sensations of tension and stiffness at the back of the neck are due to normal strain and pressure sensations which have been brought to our attention due to the perceived attention of another. These sensations combine with the general feeling of nervousness.

Titchener fails to provide any details of the experiments he conducted, and there is no record of the particular methodology he followed or details of the findings he obtained. He reports his findings with an evident bias and with an aim to deny the existence of any explanation for the phenomenon he was investigating bar a purely psychological one. Titchener's (1898) paper was heavily criticised for its biased stance (Hodgson, 1899)[1], which resulted in a heated exchange of

[1]Due to the referencing conventions of the time, it is difficult to know exactly who wrote this article. However, archival research indicates that it was most likely the Editor of the *Journal*

correspondence in the journal *Science* between Titchener and William James (James, 1898; Titchener, 1899a; James, 1899a; Titchener, 1899b; James, 1899b; Titchener, 1899c). James's scathing dismissal of Titchener's criticisms resulted in James concluding of Titchener that;

> "May the consciousness of his fidelity to correct scientist principles console him in some degree both for his deafness and his isolation."
>
> (James, 1899a, p. 655)

However, even in light of this criticism, Titchener's (1898) research does propose an interesting psychological mechanism for remote staring detection. Although this mechanism is somewhat simplistic and fails to incorporate the various social interactions where this type of phenomenon could take place, it does suggest that the perceived 'paranormality' of this phenomenon could be due to a form of 'selective attention'. Essentially, the starer (i.e., the person who is staring) naturally looks at the head and face of a person who is turning around to look at them, and the staree (i.e., the person who is being stared at), when combining this with a feeling of nervousness, perceives this as remote staring detection. This mechanism, or a more complex mechanism which combines other elements such as selectively recalling instances when a person feels that they are being remotely stared at and there is someone there, and forgetting instances when there is no one there, could potentially explain many of the anecdotal experiences related to remote staring detection. This is particularly valid because it is often difficult to assess the 'paranormality' of such events as they are under conditions that are not experimentally controlled. However, this proposed mechanism begins to have problems explaining examples where the physical relationship between starer and staree have been separated under experimental conditions in order to control their degree of interaction.

This motivation can be seen in the next reported set of experiments into this area, which were conducted by Coover (1913). He recruited 10 participants from the 'believers' amongst his General Psychology class, and he[2] sat behind them and stared at them 100 times for 15 to 20 second durations, based on a pseudo-randomised schedule. After each staring period, the participants were asked to note their experience of being stared at. Coover (1913) reports that

of Psychical Research the the time, Richard Hodgson. I would like to thank Dr Melvyn Willin, Wyllis Poynton, and Dr Alan Gauld for their help in the archive search.

[2]Coover acted as the starer for only five of the participants, different experimenter/starers were used for the final five.

out of 1000 guesses, only 50.2% were accurate, and he concluded that this result was indistinguishable from chance. He also did not find any relationship between the guesses and the distance between the starer and staree, or how certain the staree was about their guess. Finally, he concluded that these results mirror Titchener's (1898) findings, and that belief in this phenomonon, although apparently common, is ultimately groundless and that the belief is probably cause by the individual "...attributing an objective validity to commonly experience subjective impressions in the form of imagery, sensations, and impulses." (Coover, 1913, p. 575).

Coover's (1913) research does have several flaws. By using himself for half of the trials, and then a variety of other experimenters for the other half, he failed to keep the potential stimulus consistent. He also had a very small number of participants (regardless of the number of staring periods), which he effectively reduced further by several different distance measures. However, unlike Titchener (1898) he did supply details of his experiments and did attempt to evaluate the phenomenon as extensively as he could. He also added to the phenomenological data on remote staring detection by reporting on the kinaesthetic impressions some of the starees reported, including; 'restlessness', 'discomfort', 'a desire to turn' and, 'a feeling of being criticised' (Coover, 1913, p. 574–575).

Nearly 50 years would pass before Poortman (1959) reported on the next piece of research into remote staring detection. Poortman's (1959) experimental method differed slightly from Coover's (1913) by having the starer and staree seated in open, adjoining rooms. Poortman himself acted as the staree, seated with his back to 'Mrs. R', the starer. Poortman felt that Coover's (1913) 15 to 20 second trial periods were too short, although his ambiguous experiential evidence fails to justify this, and the starer in his experimental periods stared for two to five minutes. The stare or no-stare trials were pseudo-randomised using a deck of cards, and in 89 trials, Poortman gave 59.55% correct answers. He declares this result "...proved to be better than Coover's 50.2%, but was not yet satisfactory." (Poortman, 1959, p. 9). He suggests through correspondance with others that his results are not significant, but a recent re-analysis of his results by Braud et al. (1993a) suggests that his data is significant (p = .04, one-tailed). Due to the discrepancy between Poortman (1959) and Braud et al.'s (1993a) analysis, and the fact that Poortman effectively only used one participant (regardess of the number of times the protocol was administered), and the poor controls which Poortman incorporated into his study, it is difficult to argue that this research represents clear experimental evidence for the existence of remote staring detection. However, in all fairness to Poortman, he does argue for the preliminary nature of his results. He also provides theoretical observations about the experiential aspects of his work, including that he felt that 'not trying' when staring might be a viable strategy, referring to this as '*second-degree attention*' (Poortman, 1959, p. 5, his emphasis), and that it was unclear if this represented the emittance of some form of 'ray' or if it was a form of telepathy. It is interesting to note that Poortman (1959) clearly identifies himself as 'being passively sensitive' (Poortman, 1959, p.8), in contrast with Titchener's (1898) pronounced disbelief in this phenomenon.

The above experiments have a number of flaws, many of which have been pointed out by other reviewers of remote staring experiments (e.g., Braud et al., 1993a; Wiseman & Smith, 1994; Schlitz & LaBerge, 1997). The main flaw that these experiments suffer from is that as the starer and staree are in the same room, then they are not adequately isolated and there might be sensory leakage between participants, although some have argued against this suggestion (e.g., Sheldrake, 2001b). Any sensory leakage between the starer and staree could severely undermine any parapsychological interpretation of the data, as any possible effect could be due to subtle (and possibly unconscious) sensory cues. If this is correct, then is is unclear why Titchener (1898) and Coover (1913) obtained non-significant results, if their participants had access to information to discern when they were being stared at by using their conventional senses to detect and evaluate non-verbal cues? These results under these circumstances may have been due to an experimenter effect, and there has been some evidence to support the theory that the experimenter himself/herself might have a significant effect when dealing with participants in this type of research (Wiseman & Schlitz, 1997, 1999). However, the complex nature of this potential effect is far from understood as many experimenters also act as the starer and therefore it could be related to an effect that the starer is bringing to the experiment.

The experimenter effect on remote staring detection is covered in more detail in section 3.5.2 on page 46, but in essence the suggestion is that an experimenter's personal views on the nature and existence of the ability to detect a remote stare might influence the results obtained. For example, in two joint experiments, Wiseman (a 'skeptic') failed to find an effect of remote staring detection, and Schlitz (a 'proponent') did find an effect. Therefore an individual who does not think that remote staring detection is possible might be less likely to obtain a significantly positive result. With regard to Titchener's (1898) work, his evident denial of the existence of this effect could have been communicated to the participants, making them *less* responsive to any non-verbal sensory cues they were detecting (or, indeed, the remote stare itself, if present). Coover (1913) does not clearly express a particular viewpoint regarding his personal belief, but Poortman's (1959) potentially positive results could be due to his apparent belief in the existence of remote staring being conveyed to his starer, making particular sensory cueing more likely. However, the fact that there lies a *possibility* that unconscious or overt sensory cueing could be present in these three studies undermines their claims that they are investigating 'remote' staring detection, regardless of the particular belief structures of the three experimenters. Titchener (1898), Coover (1913), and Poortman (1959) are obviously following their own agenda when investigating this phenomenon. To their credit they have helped to form a bedrock for future investigations, but these researchers were trying to conduct research without employing a satisfactorily rigorous methodology.

Peterson's (1978) work represents a significant step forward in attempting to address the issue of sensory cueing, and the introduction of a more rigorous methodology. Peterson (1978) initially ran two pilot studies, the methodology of the first being reminiscent of previous research, the second incorporating a *closed-circuit television system* (CCTV), both of which Peterson found unsatisfactory. Peterson (1978) eventually settled upon using a one-way mirror system to separate his participants, reasoning that this still allowed them to see one another, but it significantly reduced the chances of sensory leakage. In order to reduce sensory leakage even further, Peterson played *white noise* (random noise) to his starees. Peterson (1978) used 18 participants, divided into nine pairs who were familiar to one another, which resulted in 36 participant trials. Peterson obtained significant results ($p = .02$), suggesting that remote staring detection is possible.

Peterson's (1978) discussion of the results is one of the most interesting aspects of the research, mainly because Peterson appears to have been unaware of the previous literature on the subject. Peterson indicates that it is unclear what classification of extra-sensory perception might be responsible for this effect; whether it is telepathy, clairvoyance, psychokinesis, or a form of all of them (as was noted section 3.1 on page 25, it has been more recently classified by some as a subsection of DMILS). Peterson discusses the possibility of removing the starer (unbeknownst to the staree) to test part of this theory, which was eventually tested by Braud et al. (1993b). Interestingly, Peterson suggests that a number of issues should be investigated in more depth, including; the experimenter effect, the use of CCTV systems to separate the starer and staree, and the use of autonomic nervous system measures, which neatly predicted the course of research into this area over the following 25 years.

Peterson's (1978) research represents one of the best pieces of research into remote staring detection to this point, but it does have its flaws. His introduction of pairs of participants, although evidently successful, can be criticised as it potentially adds another variable by having different starers as well as starees each time. More serious is that, due to the set-up of this experiment, the experimenter was removed from the starer and staree during the session and this enabled the starer to potentially indicate session information to the staree (either deliberately or accidentally). The use of CCTV would have helped to prevent this second problem, and although Peterson (1978) rejected this technique for being unsuccessful in the pilot work, it was used successfully by Williams (1983).

Williams's (1983) research incorporated many of the features seen in the previous literature, but also managed to successfully introduce the use of CCTV as a preventative measure to sensory leakage. The use of CCTV allowed the starer and staree to be separated by a considerable distance (in this case, 60ft), and yet the starer could still see the staree, but without the risk of the staree seeing the starer. Williams (1983) also introduced a personality measure by investigating if 'believers' in extra-sensory perception performed better at detecting a remote stare compared with 'disbelievers'. Williams assigned 14 'believers' and 14 'disbelievers' to act as the staree, and 28 'believers' and 28 'disbelievers' to be the starer, where (unbeknownst to the staree) a 'believer' and a 'disbeliever' stared at each staree pseudo-randomly during the experimental trial. Williams (1983) found that overall there was a (borderline) significant effect ($p = .049$) of the remote stare. Interestingly, Williams found that this effect was due to the 'believers' detecting the stare more accurately than the 'disbelievers' ('believers' obtained $p = .037$ significance, the disbelievers did not obtain significant results[3]). Williams's (1983) research provides an interesting aspect to the remote staring research with the introduction of a personality measure and the successful introduction of the use of a CCTV system.

However, one fundamental issue with the use of CCTV systems is their effect upon the phenomenon being studied. As can be seen from Williams's (1983) and later research, CCTV does not appear to have a significantly adverse effect upon the detection of a remote stare, but it does have consequences for the theory behind the effect. As can be seen as far back as Titchener (1898), the anecdotal reports of remote staring detection centre around a *direct* stare between the starer and staree, namely no mirrors, CCTV systems or intervening

[3]Williams (1983) fails to report the significance level of the 'disbelievers' statistic.

systems. As will be discussed later, the DMILS element of *intention* might be able to help explain this, but it might be equally possible that the anecdotal reports of remote staring detection, if genuinely 'paranormal', might represent a different, if phenomenologically similar, type of phenomenon compared to the remote staring effect which has observed in the laboratory. This may go some way in explaining the different results between lab-based and 'real-world' based research, as discussed later in this chapter.

Williams's (1983) work represents the last of the 'early research', namely the research which was conducted before Braud et al.'s (1993a, 1993b) publications significantly influenced the types of methodology used in researching remote staring detection. Although some of these early studies were potentially flawed, they did assist in the formulation of more stringent measures that could be employed in future investigations of remote staring. It is easy to see the evolution of the experimental technique in these early studies, culminating in Williams's (1983) study. This, along with Peterson (1978), offered an important conceptual change. Up until this point the few studies that had been done in this area (Titchener, 1898; Coover, 1913; Poortman, 1959) had high ecological validity by using people in the same room, but suffered from the lack of experimental controls. However, the studies by Peterson (1978) and Williams (1983) showed that it was possible to reduce the ecological validity of the study by employing more stringent controls and still obtain significant results. This concept can be seen in the next development of this research.

3.3 The introduction of the electrodermal activity measure

Braud et al. left a lasting impression on the face of remote staring research with two papers which they published in 1993 (Braud et al., 1993a, 1993b). As the two papers used identical equipment, and the same basic procedures and analysis, they will be discussed together.

Braud et al. (1993a) initially proposed a summary of results from the previous remote staring studies conducted. Their summary is presented in table 3.1 on page 34. They concluded from this data that there was a consistent effect present, but it was not striking and they suggested that this might be because of the use of conscious guessing as the dependent variable. Braud et al. (1993a) suggested that;

Researcher	Design features	Scoring rate (%)	Effect Size
Titchener (1898)	No data reported	—	—
Coover (1913)	Same room	50.20	.004[a]
Poortman (1959)	Adjoining rooms	59.55	.18
Peterson (1978)	One-way mirror	54.86	.42
Williams (1983)	CCTV system	51.31	.32

[a]Effect size for Coover (1913) calculated by Braud et al. (1993a)

Table 3.1: Summary of results of the early remote staring research (adapted from Braud et al., 1993a)

> "Such a procedure would be expected to maximize possible cognitive interferences and distortions of subtle internal staring-related cues..."
>
> (Braud et al., 1993a, p. 376)

As an alternative to using conscious guessing as the independent variable, Braud et al. (1993a) suggested the use of phasic *skin resistance response* (SRR), mainly because they interpreted the anecdotal reports as having a number of somatic features (such as tingling of the skin, prickling of the neck hairs, etc) which can be related to physiological activity, and they thought that SRR would allow a relatively easy and consistent measure of the autonomic system. Braud et al. (1993a) concluded that this would enable the staree to respond to the starer's stare without the 'contamination' of their cognitive processes. This dependent measure was combined with the use of a CCTV system to prevent sensory leakage between the starer and staree.

Braud et al. (1993a) combined this method with a further experimental manipulation. They separated their 32 participants, ostensibly from the same general participant pool, into two groups of 16 participants; 'Phase one' of the experiment used *untrained* participants, 'Phase two' used *trained* participants. The trained participants underwent 20 hours of 'connectedness' training, incorporating taped material, discussions, lectures, and experimental exercises (including staring into another person's eyes for a long time), in order to make them more comfortable with 'connecting' with others. The experimenter (who also acted as the starer) also underwent the training at this time. The untrained participants obviously did not have this training.

During both experimental phases, all participants had their SRR recorded whilst they were stared or not stared at for 30 seconds (with ten stare and ten non-stare trials). Interestingly, Braud et al. (1993a) found that both the untrained group (p = .018, two-tailed), and the trained group (p = .048, two-tailed) demonstrated a difference between staring and non-staring periods. However, the untrained group was significantly *activated* by the remote stare, and the trained group was significantly *calmed* (as measured by SRR), to the point that there was a significant difference between the two groups (p = .002, two-tailed, *post-hoc* analysis). Braud et al. (1993a) argue that these results suggest that the measurement of SRR might be a more viable method of assessing remote staring detection, as the calculated effect sizes of the trained and untrained participants (.59 and −.50 respectively) are more impressive that the effect sizes from previous studies[4], as shown in table 3.1.

Braud et al. (1993a) concluded from these results that the training that the phase two participants received calmed them and enabled them to feel 'connected' with, rather than anxious of, the starer. In fact a number of the participants reported that they found the staring encounters resulted in "...positive and pleasant interactions..." (Braud et al., 1993a, p. 386).

Braud et al. (1993b) followed-up their initial research with a separate set of studies designed to replicate and extend upon their initial findings. This research was effectively comprised of three separate studies; 'Replication one' used three separate starer/experimenters who had been trained by the starer/experimenter from their previous research (i.e., Braud et al., 1993a), each using 10 participants as starees. The second study, 'Replication two', used 16 participants and the starer from their previous research (i.e., Braud et al., 1993a). The procedure of this study differed slightly from previous studies as it comprised of 32 stare/non-stare periods, divided into an 'experimental' half (eight stare and eight non-stare periods) and a 'sham' half (eight stare and eight non-stare periods). When discussing the 'sham' half of the second study, it is often referred to as a separate study (see Braud et al., 1993b; Schlitz & Braud, 1997) as it was incorporated into this research as a method of providing artefactual control and, as will be seen, assisted in theoretical development. During the 'experimental' half of the experiment, the starer acted according to the procedure in the previous studies, in the 'sham' half, the CCTV monitor to the starer was turned off and the starer was encouraged to 'forget' about the experiment (these conditions were reversed for half of the participants). Braud et al. (1993b) also used a Social Avoidance and Distress Scale (SAD) (Replication one and two) and the

[4]However, as Braud et al. (1993a, p. 386) note, these effect sizes are not directly comparable as the effect sizes for Coover (1913) and Poortman's (1959) studies are based on trial units, whereas the other effect sizes are based on participant units.

Myers-Briggs Type Indicator (MBTI) (Replication two only).

In Replication one, Braud et al. (1993b) found almost significant results ($p = .06$, two-tailed). In the the experimental half of Replication two they did find significant results ($p = .05$, two-tailed), and the expected non-significant results in the sham half of the study ($p = .76$, two-tailed). In both of the experimental conditions, the SRR results indicted that the participants were *calmed* by the remote stare. Braud et al. (1993b) also found that the SRR positively correlated with the SAD scores (Replication one, $p = .05$; Replication two, $p = .09$), and that the SRR also positively correlated with the MBTI introversion scores ($p = .003$). These results suggest that as the more socially anxious or introverted a participant was, the *more calmed* they became during the staring period, although as Braud et al. (1993b) point out, due to the high correlation between the SAD and MBTI introversion scores ($p = .035$), one of them may be acting as a moderating variable.

Braud et al. (1993b) suggest that the calming nature of the stare in the different replications is not unexpected as the same starer was used in this study as the last one for one of the replications, and this starer acted as the trainer for the three starers used in replication one. Braud et al. (1993b) suggest that the participants might be finding the stare calming because the starer/experimenter engenders a greater degree of 'connectedness' or calm, even though none of the participants in this study underwent the 'connectedness' training of the last study.

What is more puzzling is the positive correlations between the SRR, and the SAD and MBTI introversion scales. Braud et al. (1993b) are careful to ensure that these analyses are exploratory and potentially bi-directional, but based on much of the anecdotal material outlined in previous studies, and the face validity of these scales, a tentative hypothesis would be that the generally more socially anxious and introverted a person is, the more anxious they might be if a person is staring at them (normally or remotely). However, Braud et al. (1993b) did not find this, and they go to great pains to try and explain this result. The explanations include that higher SAD scorers might be more 'needy' to connect with others, or happier working alone, or more sensitive to social situations and they respond appropriately to the remote stare. Similar explanations are offered for the higher MBTI introvert scorers, that introverts might be calmer sitting alone in a room, or that introverts have greater sympathetic autonomic arousal than extroverts, and excitation might be lower. However, all of these potential explanations ignore some fundamental issues about the experiment. Firstly, the number of participants that these figures are based upon is considerably low to be suggesting such broad-sweeping arguments (particularly the MBTI, which was administered to only 16 people). There are also issues with arguing that 'introverts', or the more socially avoidant are definitely calmed by a remote stare, when the participants were not pre-selected as highly representative of these personality characteristics. The correlations between these questionnaires and the SRR scores might only be representative within the sample, and not generalisable to the population as a whole. Also, the procedures between the two experiments, although similar, were different enough to add the possibility that the participant's activity may have introduced confounding variability to the personality test scores. This is highlighted by the fact that in replication one the participants completed the personality tests after the experimental testing, in replication two the personality tests were completed *during* the experimental testing. It is, of course, possible that the unexpected results from these personality tests could be because the tests themselves were inappropriate for the experiment and alternative measures should be used in future research.

Even with these potential criticisms, the research presented in Braud et al. (1993a) and Braud et al. (1993b) represented a significant development in remote staring research. Braud et al.'s (1993a, 1993b) research demonstrated that any potential cognitive interferences could be successfully reduced with the introduction of electrodermal activity measures, and that minimising the potential for sensory leakages with the use of CCTV systems did not appear to impair the detection of a remote stare. Braud et al.'s (1993b) introduction of the 'sham' control not only acted as an artefact control, but also suggested that the starer themselves are a key element of the detection of a remote stare, and that the absence of a remote starer eliminates the effect. Although this finding requires further investigation, in the difficult theoretical explorations in parapsychology this finding assists in the understanding of the phenomenon. It suggests that the starer is an integral part of the remote staring phenomenon, and that it is unlikely to merely be the staree reacting to another variable or interacting with the environment entirely independently of the starer. Braud et al.'s (1993b) research also expanded the theoretical understanding behind the detection of a remote stare by finding evidence that suggested that the relationship between the starer/experimenter and the staree could significantly moderate the physiological mechanisms measured in the staree, an issue which is explored in more detail in the next section.

Although Braud et al.'s (1993a, 1993b) research was the first time that electrodermal measures had been taken during a remote staring detection experiment, three years prior to their work Cacioppo, Rourke, Marshall-Goodell, Tassinary, and Baron (1990) published a paper that was ostensibly the first piece of research using a pseudo-remote staring detection method with electrodermal measures, although they referred to it as 'mere observation', and it had some important methodological differences. Cacioppo et al. (1990) were examining Zajonc's (1980) theory of social facilitation, in that even mere presence or observation increased physiological arousal, which ties into the effects of observation on task performance. Cacioppo et al. (1990) were working with the physiological reactivity model, which states that "... mere observation should increase the strength of the excitatory responses to innocuous stimuli without necessarily increasing the level of general physiological arousal..." (Cacioppo et al., 1990, p. 179). They tested 27 healthy females in an experiment that involved a subtle, but significant, difference in procedure from the remote staring detection experiments in the parapsychological literature. After they were placed in the testing room and the skin conductance, heart rate, respiration and electromyographical electrodes were attached, participants were told one of two sets of instructions depending upon which condition they were in. In the *observed* condition, they were told a series of panels from the wall's sound attenuation material would be removed so that the experimenter could watch the participant through a one-way mirror during the calibration period and the experiment. In the *unobserved* condition, participants were told the same, but that these panels would only be removed during the experiment, and not during the calibration period. This is different from parapsychological studies, as in such studies the participant would not be informed of when they might be stared at, as this knowledge might result in a change in behaviour or physiology that is not related to the remote stare, but due to the procedure. Cacioppo et al. (1990) found that there were no significant differences between the groups for any of the physiological measures during the 'calibration' period. When they administered simple tones to the participants during the experimental period, they found that observation did enhance nonspecific physiological activity, particularly skin conductance, but the activity quickly recovered, suggesting that "... mere observation did not enhance general physiological arousal per se." (Cacioppo et al., 1990, p. 182). They interpreted these results in terms of mere observation having a more complex effect on arousal than was previously thought, and that it could "... elevate physiological reactivity to environmental changes." (Cacioppo et al., 1990, p. 183). Although this paper cannot be considered as providing evidence for remote staring detection in a direct sense, because the participants knew when they would be observed, it does provide useful methodological and conceptual evidence that can be used to inform the development of the methodology of remote staring detection experiments. Firstly, as there was no difference between the two groups in the calibration period, it suggests that merely having knowledge that one could be being stared at does not impact upon one's physiological arousal. Therefore, informing participants in a remote staring detection study that they might be stared at remotely at random intervals should not affect their physiology in a manner that is adverse to the experiment's aims. Secondly, in many remote staring detection experiments, participants who are acting as the staree are asked to sit quietly during the session (e.g., Braud et al., 1993a), or are shown a display of random, amorphous colours similar to some computer screen-savers (e.g., Schlitz & LaBerge, 1997). However, the results from Cacioppo et al. (1990) suggest that it might be more constructive to measure staree's physiological responses to other stimuli, such as tones or images, as being observed appears to impact upon the responses to such stimuli, but not necessarily on general levels of physiological arousal. This would also be more analogous to how remote staring detection might possibly work under 'real-life' conditions. Although the processing of potential parapsychological phenomena are evaluated under strictly controlled conditions in the laboratory that isolates them against any other confounding variables, if they occur in everyday life, then they will occur alongside the processing of more conventional stimuli, and will be presented as part of the field of experience. Therefore, studying the processing of remote staring detection and other parapsychological phenomena might be more productive if they are also examined alongside the processing of more conventional stimuli, such as tones and images. It is more interesting for the participant, and is potentially more ecologically valid.

In the discussion of their study, Cacioppo et al. (1990) provide details of an interesting survey that they conducted of all authors of papers using electrodermal measures published in *Psychophysiology* from 1983 to, presumably, 1990 (the date of publication of the paper). Of 107 potential respondents, they received 57 responses, and they found that 49% of experimenters had set-ups where the participant was clearly visable to the experimenter, and a further 30% had a set-up where a videocamera was clearly visable to the participant. If the evidence from the remote staring detection studies is correct, then it suggests that 79% of the respondants from Cacioppo et al.'s (1990) survey have experimental set-ups where remote staring detection could act as a potential confounding variable in their experiments. Although it is, of course, very difficult to construct an experimental set-up that avoids this, experimenters need to be aware of this potential effect. The difficulty in eliminating this potential effect is a prime example of how certain parapsychological phenomena, if proved reliable, could confound the results of a great number of experimental studies in psychology, psychophysiology and physics.

3.4 Personality correlates

Several studies have employed questionnaire measures in order to examine potential personality or belief correlates with the lab-based measures of remote staring detection. These measures have been used to varying degrees of success. The first reported study to use questionnaire measures was Williams (1983), who used a 10-item paranormal belief scale (referred to as a 'Sheep–Goat' scale) to examine if belief in paranormal phenomena was a correlate of successful remote staring detection. Williams (1983) reported that there was a significant difference, with the individuals identified as more believing (i.e., the 'sheep') performing better than those that reported lower levels of belief (i.e., the 'goats').

As has already been noted in the last section, Braud et al. (1993b) used more extensive psychometric measures in their study. They found a significant positive correlation between remote staring detection and both the Social Avoidance and Distress scale (SAD) and the Myers-Briggs Type Indicator (MBTI). These findings led Wiseman and Smith (1994) to use the Revised Cheek and Buss Shyness scale (RCBS) in their study because they felt that Braud et al.'s (1993b) use of the SAD scale was "...conceptually similar to shyness." (p. 467), which is debatable. They also asked questions concerning participants attitudes towards 'psi', and their level of perceived luckiness (three questions for each measure). Wiseman and Smith (1994) did not find any significant correlations between any of these measures in their first experiment, and only the RCBS was approaching a significant positive correlation with the remote staring detection measure in the second experiment.

Following up on this, Wiseman, Smith, Freedman, Wasserman, and Hurst (1995) used the same questionnaire measures as Wiseman and Smith (1994). They did not find any significant correlations with the remote staring detection measure in their first experiment. In their second experiment, they reported that the belief in psi measure was significantly negatively correlated with the remote staring detection measure, and the RCBS was once again approaching significance.

Schlitz and LaBerge (1997), following-up on Braud et al.'s (1993b) research, did not find any significant relationships with the SAD measure and remote staring detection. In a similar vein, Wiseman and Schlitz (1997, 1999) did not find any significant correlations with the experimental measure with their three-item belief in psi measure in either of their studies. This was later followed-up by Watt, Schlitz, Wiseman, and Radin (2005), who found that participants belief in psi appeared to be unrelated to session outcome.

Finally, Lobach and Bierman (2004) used the 14-item 5PFT extroversion scale, and found evidence to suggest that extroversion might be associated with successful remote staring detection.

As can be seen, the measurement of personality correlates in remote staring detection research has provided mixed results. There is some evidence that remote staring detection is correlated with social avoidance and shyness, and belief may also play a role, but the evidence is not particularly clear. This might be because an optimal measure has not yet been employed. The use of social avoidance and shyness scales may have a certain validity based upon a potential emotion reaction to remote staring detection (i.e., anxiety and fear, see Thalbourne & Evans, 1992), but the desire to avoid certain social situations might only be part of the underlying psychological sensitivity to remote staring detection.

Possibly a better measure would be that which attempts to evaluate degrees of *self-consciousness*, that is the "...extent to which subjects perceive another's behaviour as being intentionally directed towards them." (Fenigstein & Vanable, 1992, p. 129). This concept can be seen as having a relationship with certain ideas surrounding the intent behind a remote stare (and wider areas of DMILS-type research), and to measures of more conventional forms of staring, as the observed in such instances will attempt to assess the mental and emotional states of the starer.

This concept of self-consciousness has been separated further into measures of *private self-consciousness* and *public self-consciousness*. Measures of private self-consciousness are concerned with a person's awareness of the inner or personal aspects of self, including one's private feelings and thoughts (Fenigstein & Vanable, 1992). In contrast, public self-consciousness measures are concerned with the self as a social object, "i.e., as an entity that is the object of awareness of others." (Fenigstein & Vanable, 1992, p. 130). These measures, combined with a measure of social anxiety, have been successfully measured by Fenigstein et al.'s (1975) *Self-Consciousness Scale* (SCS), with Burnkrant and Page (1984) and Mittal and Balasubramanian (1987) providing further analysis and alterations on the loadings of the factors.

Related to the above scale, and to evaluations of self-consciousness, is the *non-clinical paranoia* scale devised by Fenigstein and Vanable (1992). This was derived from items from several paranoia scales, including the MMPI[5], but as these scales focused on pathological paranoia, Fenigstein and Vanable (1992) concentrated on questions which focussed on the non-clinical elements of paranoia. This included focussing upon questions that emphasised a "belief that people or external forces are trying to influence one's behaviour or control one's thinking", and a "belief that some people talk about, refer to, or watch one" (p. 131), both of which are relevant to the beliefs and experiences surrounding remote staring detection. This resulted in a 20-item paranoia scale which correlated well with Fenigstein et al.'s (1975) public self-consciousness measure ($r_{(581)} = .40$, $p = .01$), and marginally with the private self-consciousness measure ($r_{(581)} = .15$), leading Fenigstein and Vanable (1992) to suggest that elevated levels of self-consciousness may lead to paranoia.

In order to introduce a behavioural measure of paranoia to further evaluate the scale, Fenigstein and Vanable (1992) turned to measures highly similar to remote staring detection, suggesting that:

> "The feeling of being watched or that others are taking special notice of one is a classic manifestation of a paranoid idea of reference ... it may be argued that this feeling of being observed derives from one's own self-directed attention."
>
> (Fenigstein & Vanable, 1992, p. 133)

In order to test this, Fenigstein and Vanable (1992) separated 40 participants into two groups. Having completed the SCS and paranoia scales several weeks before, the participants were asked to come to the lab and complete an anagram experiment. Individuals of one group were asked to wait for five minutes on their own in a room with a large one-way mirror in it. Individuals from the other group were asked to wait in a room without a mirror. After this, they completed a six-item questionnaire where the most important question concerned to what extent they felt they were being watched during the waiting period, on a 10-point scale. In the second part of the experiment, the members of the first group (or 'mirror' group) was asked to solve anagrams in a room *without* a mirror, whereas the second group solved anagrams *with* a one-way mirror in it, reversing the roles.

[5]The Minnesota Multiphasic Personality Inventory. The measures of paranoia in this scale were based upon experimentally induced paranoia.

Again, both groups were then asked to complete a questionnaire concerning to what extent they felt that they were being watched during the anagram task. Unfortunately, Fenigstein and Vanable (1992) introduced a potential confounding variable to this experiment, as during the waiting period, the members of the group *were not* watched by an observer via the one-way mirror, but during the anagram task the group members *were* watched via the one-way mirror. As Fenigstein and Vanable (1992) amalgamated both groups for their analysis, they did not explicitly test what impact this remote staring detection may have had on one half of the sample.

However, Fenigstein and Vanable (1992) did find that there was a significant relationship between the feeling of being watched (i.e., the presence of the mirror in this case) and both the paranoia and public self-consciousness scales. They also replicated this finding in a similar, second experiment.

The experimental evidence presented by Fenigstein and Vanable (1992) demonstrates a meaningful potential link between measures of self-consciousness and paranoia, and both awareness and sensitivity of conventional forms of staring, and remote staring detection. This makes the SCS and paranoia scales ideal candidates to help further understand the potential correlates between personality measures and remote staring detection, which may ultimately act as predictive factors for future experiments.

3.5 Methodological issues

3.5.1 Criticism of EDA usage

The introduction of electrodermal activity measurement and analysis had a significant impact upon the methodology of remote staring detection studies, and indeed in DMILS studies in general. Its relatively easy set up and its high degree of variability as a measure of autonomic nervous system activity allowed it to become an optimal technique for the evaluation of effects of distant intentionality and remote staring detection. The dominance of EDA methods was noted by Schmidt and Walach (2000), and they were concerned that parapsychology was not following the standardised EDA methods that have been agreed by psychophysiologists, the most important publication being Fowles et al.'s (1981) *"Publication Recommendations for Electrodermal Measurements"* published in *Psychophysiology*. Schmidt and Walach (2000) pointed out that it was essential that parapsychology studies follow these guidelines, and most importantly provide an adequate description of the techniques and procedures used in the studies so that they are clear for future meta-analytic evaluation. They proceed to summarise optimal EDA measurement procedures, with possibly the most important recommendations involve the use of *skin conductance level* (SCL) over other measures, specific electrode and gel types, and electrode location. The emphasis on SCL is particularly important as several different tonic and phasic measures[6] of EDA have been reported in the parapsychological literature, but Schmidt and Walach (2000) argue that "...for DMILS/remote staring, only tonic parameters are necessary as there are no specific stimuli and we are usually interested in participants' arousal during different epochs." (p. 147).

In order to appraise parapsychology's adherence to these standardised methods, Schmidt and Walach (2000) evaluated 39 EDA studies published in *Psychophysiology* and the *International Journal of Psychophysiology* from 1995 to 1999, and compared their methodological rigour with all DMILS and remote staring detection studies that used EDA as a dependent variable (25 studies at that time). Although the basic recording standards proposed by Fowles et al. (1981) are met by the psychophysiological studies, although with less homogeneity than expected, only a handful of the recommendations are met by the minority of the parapsychological studies. Particularly alarming was a noted shift in the literature from the measurement of phasic responses to tonic responses, without any justification of why.

In some respects, Schmidt and Walach (2000) could be criticised for producing a paper that is unnecessary as the majority of the material they cover on the practicalities of EDA measurement has been covered in other publications (e.g., Fowles et al., 1981; Dawson et al., 1990; Bouscein, 1992). However, the widespread neglect or ignorance of this standardisation of EDA measurements by parapsychologists mean that Schmidt and Walach (2000) made an important contribution in teaching and reinforcing methodological rigour in the field. The lack of reference to Fowles et al. (1981) by parapsychologists is a particularly regrettable omission, as it is such an important reference for standards in EDA measurement. This lack of awareness of appropriate EDA methodology means that the findings from some DMILS and remote staring detection studies need to be treated with caution, as the irregularities in methodology may have introduced

[6]Essentially, the *tonic* measure of skin conductance reflects the average level of skin conductance activity over a period of time, and is referred to as the *skin conductance* level (SCL). The *phasic* measure of skin conductance is the rapid change in skin conductance as a reaction to a stimulus, referred to as *skin conductance response* (SCR), and this can be defined by several different parameters (Dawson, Schell, & Filion, 1990; Schmidt & Walach, 2000).

errors in the results or interpretation of the findings. Certainly future work needs to be aware of these issues.

Based upon the findings of Schmidt and Walach (2000), Schmidt, Schneider, Binder, Bürkle, and Walach (2001) proceeded to re-arrange their laboratory and the specific EDA measurement procedures that they employed. As a consequence of this, they were left with three questions: (a) Is the measurement of phasic or tonic components more optimal within DMILS research? (b) What is the relationship between EDA, respiration and DMILS? and (c) What are the best statistical procedures to adopt with DMILS and remote staring data? In order to examine these questions, Schmidt et al. (2001) conducted two DMILS pilot studies in parallel as exploratory experiments, and analysed the data from both studies together. This resulted in a total of 26 sessions in the analysis, which were recorded using the measurement recommendations outlined in Schmidt and Walach (2000).

Schmidt et al. (2001) found that there were no substantial differences between the phasic and tonic analyses, and that that there was a significant relationship between SCR, irregular respiration and the DMILS effect. This finding led to the development of standardised procedures for the analysis of EDA and respiration (Schneider, Schmidt, Binder, Schäfer, & Walach, 2003). However, the respiration measure that they employed does have a considerable practical disadvantage in that is reliant upon manual data entry, with the potential for human error and bias, instead of automated analysis procedures. Finally, Schmidt and Walach (2000) argue against the use of the *Percentage Influence Score* (PIS), which was developed by Braud and Schlitz (1991) and has been used in several DMILS studies, as it is only standardised by the mean and not the standard deviation, and they also argue against using paired t-tests as psychophysiological data is often not normally distributed, although the distribution can be evaluated prior to the analysis. Schmidt and Walach (2000) do recommend the use of Wilcoxon Signed-Ranks tests as an alternative, or the use of a randomised permutation analysis.

As with Schmidt and Walach (2000), Schmidt et al. (2001) highlight important practical issues in the analysis of EDA that many of the remote staring detection studies from Braud et al. (1993a) onwards fail to acknowledge, and therefore some of the findings from these studies needs to be questioned with regard to their methodological rigour.

3.5.2 The experimenter effect in remote staring studies

The effect of the experimenter in parapsychology experiments is potentially important, as they could not only have a conventional impact upon the running of the experiment (i.e., with regard to interactions with the participant), but it has also been suggested that their own psi abilities could play a role, and therefore it has been strongly argued that the effect of the experimenter should be closely examined (J. Palmer, 1997). Some of the remote staring literature has been seen as a prime example of the experimenter effect, and this is typified by the research of Richard Wiseman and Marilyn Schlitz.

This line of research began with a study by Wiseman and Smith (1994), which reported two experiments looking at remote staring detection in an attempt to find methods of evaluating psi-performance that are quick to run, require relatively little equipment, and most importantly, produce reliable and positive results. Wiseman and Smith's (1994) experiments employed a considerably different methodology than both previous and subsequent remote staring detection studies in that they used multiple starers for each staree, rather than a one-on-one method. In their first experiment they used 15 starers at a time, situated behind a one-way mirror, who were trying to influence two starees (separated by a dividing screen). After testing 60 participants, Wiseman and Smith (1994) failed to find any remote staring detection effect, or any correlation with questionnaire measures of psi-belief, perceived luckiness, or shyness. As a consequence of these findings, Wiseman and Smith (1994) decided to try Braud et al.'s (1993a) suggestion that unconscious measures might prove more successful, and therefore employed EDA methods. They were also concerned about sensory leakage with the use of the one-way mirror, and decided to use the more stringently controlled CCTV method.

In their second experiment, using 30 participants, Wiseman and Smith (1994) had a similar set-up as before, with a group of starers staring at two starees, but this time it was via a CCTV system, and EDA was used instead of a behavioural measurement. They initially found a significant difference in the mean EDA for the stare vs. the non-stare trials, but no correlations with the questionnaire measures. However, during a closer analysis of the data, Wiseman and Smith (1994) reported an anomaly in the randomisation of the stare and non-stare periods, where the stare periods significantly proceeded the non-stare periods. They argued that, due to EDA decreasing as participants become more relaxed over time, then this could have resulted in higher EDA values for the stare periods compared to the non-stare periods. Subsequent re-analysis of part of this dataset by Sheldrake (2005a) suggests that this hypothesis of EDA decline is incorrect, but Sheldrake (2005a) fails to provide details of his re-analysis for closer evaluation.

In reality, many EDA measures (depending upon the exact measure) do demonstrate a downwards drift over time when subjects are at rest. This drift can be anywhere up to 3 microsiemens (μS) (Dawson et al., 1990), followed by a rapid increase when a novel stimulus is administered, and a gradual decrease when the stimulus is repeated due to habituation (see Motagu, 1963, cited in Dawson et al., 1990). However, these tonic shifts can be corrected for over the entire recording, and depending upon the specific measures and with adequate randomisation, should not affect the overall analysis.

Following Wiseman and Smith (1994), Wiseman et al. (1995) report two experiments which differed from the previous study in that the set-up was more reminiscent of the experiments conducted by Braud et al. (1993a), with one starer and one staree, and with better randomisation procedures, and one male and one female experimenter in order to examine the effects of gender interaction. In the first experiment, they tested 22 participants (based upon the effect sizes from Braud et al., 1993a), using both male and female experimenters acting as starers. They found no overall effect of remote staring detection, or any gender differences, or any correlations with the questionnaire measures (using similar questionnaires to Wiseman & Smith, 1994). In their second experiment, Wiseman et al. (1995) use improved randomisation procedures, and provide the staree with a task during the experiment, which was to complete the questionnaires. However, this could have introduced a confound to the questionnaire data, particularly the shyness scale, due to the psychological impact of thinking that they were being stared at remotely. Over 20 participants, tested by both male and female experimenters, showed no significant effect for remote staring detection, and there were no significant effects of gender.

The next study that is important for understanding the potential experimenter effect was reported by Schlitz and LaBerge (1997). They tested 39 participants over 48 sessions with five different starers (three males and two females). Although they used EDA measures, there is some confusion in the paper over the specific measure used. They report in the procedure that the EDA equipment measured "...spontaneous phasic skin conductance responses..." (Schlitz & LaBerge, 1997, p. 190), or phasic SCRs, but in the result section report the analysis of "...mean values of skin conductance level ..." (Schlitz & LaBerge, 1997, p. 191), or SCL. Although this might appear to be a minor point, the two terms refer to very different measures. The phasic SCRs comprise of only a small fraction of the SCL, and have been "...likened to small waves superimposed on the tidal drifts in SCL" (Dawson et al., 1990, p. 302 discussing Lykken & Venables, 1971). Although Schlitz and LaBerge (1997) are most likely referring to the measurement of SCL, this ambiguity means that their results need to be interpreted cautiously. Schlitz and LaBerge (1997) report that they found an overall effect of increased skin conductance when the starers were being stared at remotely, and that opposite-sex pairs of starer-staree demonstrated a significantly larger effect.

These three studies led to Wiseman and Schlitz collaborating in order to discover if the differences in the findings from their studies could be potentially due to an experimenter effect (Wiseman & Schlitz, 1997), based on the argument that Wiseman is sceptical of the existence of psi, but Schlitz is a proponent. In order to examine this, they conducted a study together, which effectively comprised of separate experiments, but using the same location, equipment and procedures, and drawing from the same participant pool. They tested a total of 32 participants (16 each), using a non-automated CCTV system and measured mean skin resistance, with randomised stare/non-stare periods. However, allocation of participants to each experimenter was not randomised, but largely opportunistic, which is a problem as they could have unintentionally selected participants that favoured a specific experimental outcome, although this is unlikely as the participants were not well known to them prior to the experiment. Overall, Wiseman found no effect of remote staring and Schlitz found a significantly higher level of mean skin resistance when participants were being stared at remotely.

In their second study, Wiseman and Schlitz (1999) replicated the procedure of their previous study (Wiseman & Schlitz, 1997), again acting as experimenter-starers, using a non-automated CCTV system, measuring skin resistance, with the same sampling method. After testing 35 participants each, Wiseman again did not find an effect of remote staring detection, but Schlitz found that participants were significantly *less* activated during the remote staring periods, a reversal of the finding in the previous study. One significant issue with both of these studies is that they used *skin resistance* as a measure. It has been argued that skin conductance forms a far superior measure, as it demonstrates a more linear relationship with the number of active sweat gland and their rate of secretion (Lykken & Venables, 1971), and therefore these results are not quite as reliable compared to the relative skin conductance findings.

In both papers, Wiseman and Schlitz (1997, 1999) proceed at the end of the papers to argue against an experimental artefact or cheating by the participants, and against experimenter fraud or a gifted population, mainly due to the experiment set-up. It is unclear why they state alternative hypotheses to explain the results, and then proceed to discount them. This is also done in other papers (e.g., Schlitz & LaBerge, 1997; Schlitz & Braud, 1997) and largely appears to be a rhetorical device in order to emphasise the empirical rigour of the researchers. It fails to clarify the findings, as several of the alternative hypotheses that are discussed should have been controlled for with the experimental procedures.[7] They continue on to suggest other explanations, namely that Schlitz may have been more successful at eliciting psi ability in the participants than Wiseman, or they used their own psi abilities to elicit the result they desired.

However, Wiseman and Schlitz (1997, 1999) fail to explicitly state that, because they both acted as starers as well as experimenters, the results could have been due to the fact that Schlitz is better as a remote starer than Wiseman. There is no evidence *per se* that the effect is due to them acting as experimenters, or more particularly, because one of them is a proponent and one is a sceptic. It could be due to their roles as starers, or because one is male and the other is female, or because of a multitude of uncontrolled variables. It is this reasoning that makes much of this line of research heavily flawed: the "experimenter effect" could be due to other variables, and the assumption that the sceptic-believer difference explains the effect is just one possible explanation out of a large number of potential explanations.

In an attempt to better understand the findings in the Wiseman and Schlitz (1997, 1999) papers, interviews were conducted with both Wiseman and Schlitz explicitly examining the differences in experimenter style (Watt, Wiseman, & Schlitz, 2002). The interviews reveal that Schlitz attempted to mentally prepare herself before an experimental session, and deliberately tried to put participants at their ease, tried to build a rapport and have a positive expectation of the experiment. When acting as the starer, she attempted to cultivate attention and intention on the staree, and then release it during the no-stare periods. She also attempted to move physically, in order to activate her own physiology and therefore activate the staree's. In contrast, Wiseman did not attempt any preparation, and approached the sessions in a matter-of-a-fact manner, with no explicit attempt at developing a rapport, but also did not volunteer the

[7] One of the main exceptions for this is experimenter fraud, but if we cannot trust experimenters to have done what they said they did, then there is no point in conducting experiments in the first place.

information that he is sceptical of the potential outcomes. When acting as the starer, he found it "...an enormously boring experience" (Watt et al., 2002, p. 21), and generally behaved quite passively. He also saw the remote staring detection processes encapsulated as "there's the action of just looking at the camera. That's the supposed effect, just by looking. That's when you get the effect." (Watt et al., 2002, p. 24). Wiseman and Schlitz appear to approach the experimental process from very different perspectives — Schlitz feels that it is not a normal psychology experiment, and in contrast Wiseman says that it is. However, the building of a rapport between the experimenter and the participant is vital in *any* psychology experiment, if only to make the participant feel more at ease under experimental conditions, and therefore the ideal is possibly somewhere between these two perspectives.

Following the two studies (Wiseman & Schlitz, 1997, 1999), and the interview (Watt et al., 2002), Schlitz et al. (in press) conducted a further replication of the experiments. This experiment had a far better design than the previous studies, as it manipulated who acted as the experimenter and who acted as the starer separately, which enabled an analysis of both the potential experimenter and starer effects. Schlitz et al. (in press) used 100 participants (25 in each manipulation), with a non-automated CCTV system and measured mean skin conductance level[8], using a permutation analysis. However, they found no experimenter or starer effects, as this time Schlitz did not find a significant effect for either measure. Schlitz et al. (in press) interpret this finding in two ways — firstly, that the effects from Wiseman and Schlitz (1997, 1999) were genuine remote staring detection effects, and the lack of an effect in this study was due to a lack of motivation. Secondly, they suggest that the findings from the first two studies were purely due to chance, and there was no "remote staring detection" effect for the three studies.

In a secondary paper, Watt et al. (2005) conducted a series of analyses using questionnaires and video recordings of the experimental interactions in Schlitz et al.'s (in press) study. Watt et al. (2005) found no significant indicators to suggest that the failure to replicate was due to Schlitz having a low rapport with the participants, a lack of focus, or low positive expectations as a starer. There were also only relatively small differences in participant's ratings of the experimenters,

[8]They claim that "in our previous collaborative projects the participant's mean SCL was used for the dependent measure" (Schlitz et al., in press), but as has been seen, this is incorrect. This error is important as it has consequences for the interpretation of the effect, as SCL and skin resistance are not equivalent, as they are not the reciprocal of one another but rather require a non-linear transformation between the two (Dawson et al., 1990).

and the experimenters did not appear to be strongly demonstrating their respective beliefs to the participants.

Due to the lack of replication, even though the study has a superior methodology compared to the previous work, Schlitz et al. (in press), and the subsequent analysis by Watt et al. (2005), has a limited contribution to the understanding of the potential experimenter effect and, even more unfortunately, the potential starer effect. Interestingly, subsequent research by Lobach and Bierman (2004) found similar effects, with no effect of remote staring detection for behavioural or EDA measures, for either reportedly 'skeptical' or 'believing' starers — although neither of these groups had a history of a particular type of effect like Wiseman and Schlitz (1997, 1999) has had.

This entire body of work (i.e., Wiseman & Schlitz, 1997, 1999; Watt et al., 2002; Schlitz et al., in press; Watt et al., 2005) has been envisioned as an exploration of the 'experimenter effect', as typified by the following; "...two researchers who have consistent track records in psi research, and who have conducted joint remote staring studies that continued to repeat their earlier pattern of results, thus demonstrating an *experimenter effect*" (Watt et al., 2002, p. 18, emphasis added). However, there are several fundamental issues with the claims being made. Firstly, there is the issue of the experimenter effect itself. Obviously, experimenters bring their own styles, abilities and beliefs to an experiment, and these can have enormous consequences on the nature and outcome of the experiment, as typified by the often-referenced R. Rosenthal (1976). Piecing together the nature of these experimenter effects and the exact impact that they can have on an experiment is difficult at the best of times, but it is made nearly impossible when examining the transient effects noted in parapsychology. It is not clear if the effects noted by Wiseman and Schlitz (1997, 1999) were because of their differences in interaction with participants, or merely because of their differences in sex. Indeed, the reversal of the effect of Schlitz's results between Wiseman and Schlitz (1997) (i.e., rise in skin resistance to remote staring detection) and Wiseman and Schlitz (1999) (i.e., reduction in skin resistance to remote staring detection), followed by non-significant results in Schlitz et al. (in press) argues for a lack of an effect, and collectively such data could be suggested as effectively cancelling all of the effects out.

Secondly, there is the issue of 'experimenter-psi', which refers to the hypothesis "...that to varying degrees experimenters psychically influence their own experiments, either directly or by releasing the psi ability of their subjects" (J. Palmer, 1997, p. 110). This is a fascinating idea, and it could apply to the Wiseman and Schlitz (1997, 1999) data, but it is exceedingly difficult to prove that any effects are in fact due to this, and not due to other experimental variables, or even due to the more conventional experimenter effects noted above, and therefore its usefulness is minimal.

Thirdly, this body of literature is strewn with references to the fact that Wiseman is a 'sceptic', and that Schlitz is a 'proponent' — in fact one of the main points that is made in Schlitz et al. (in press) is that the paper represents a collaboration between these two perspectives. The sceptic-proponent dichotomy is a familiar spectre in parapsychology, with one of the most renowned collaborations being Hyman and Honorton's (1986) joint communiqué. However, although collaborations between differing perspectives can be useful and productive, the false sceptic-proponent dichotomy has been possibly one of the most damaging schisms to have been inflicted upon parapsychology over the past 20 years. The position of a researcher on the divide is entirely relative, and is dependent upon the people involved, and the formation of self-identified camps of 'sceptics' and 'proponents' within parapsychology has resulted in political in-fighting to the detriment, not enhancement, of the research. Although Wiseman and Schlitz have had the best of intentions with their studies, they have unintentionally reinforced this false dichotomy when parapsychologists should be attempting to break it down. Regardless of how naïve it may seem, there should be an attempt to develop the most robust and rigorous methodologies possible in order to research phenomena as controversial as those studied in parapsychology, paying little attention to the relative position of an individual researcher on the false sceptic-proponent dichotomy.

Finally, the experimental designs of Wiseman and Schlitz's (1997, 1999) studies do not disentangle the effect of the experimenter, and the effect of acting as the starer. Although Schlitz et al.'s (in press) study does attempt to remedy this issue, the lack of any effect for this study does not bring resolution to this issue. As many of the studies in the remote staring detection literature combine the role of experimenter and starer, this issue is not isolated to Wiseman and Schlitz's (1997, 1999) studies, but this combination of roles ultimately undermines their endeavour to examine the experimenter effect.

3.5.3 Methodological divergence

As I have previously summarised (I. S. Baker, 2005), there is a continuum of remote staring detection studies which can be distinguished by the type of methodology that is employed, and this is demonstrated in figure 3.1. As seen in section 3.2 on page 26, research into remote staring detection grew out of anecdotal reports of people experiencing remote staring detection in everyday life. This resulted in some of the earliest studies using 'direct looking' methods, where starer and staree were effectively located in the same room. The continuum then proceeds with 'window' experiments, where starer and staree are separated on either side of a window, followed by the 'one-way mirror' experiments, and finally by experiments that separate the two individual by a CCTV system. As can be seen, these studies offer an increasing degree of control over extraneous variables, but at the potential cost of greater ecological validity. However, I have argued that the effect of the greater controls offered by methods on the one side of the continuum means that the experiments that have employed the CCTV system method should be considered separately from other methods, particularly the direct looking experiments (I. S. Baker, 2005). But, before considering this argument in more depth, it is necessary to summarise the findings and issues surrounding the experiments that have not used the CCTV system method. The earliest studies to do this, and the subsequent methodological development of the area, have been summarised in section 3.2 on page 26, but Rupert Sheldrake has been one of the staunchest advocates of a return to these methods and has conducted an alternative line of research since Braud et al.'s (1993a, 1993b) introduction of EDA methods, using primarily direct looking methods. An evaluation of his research, and that of his critics, in essential for understanding the nature and development of research into the remote staring detection effect.

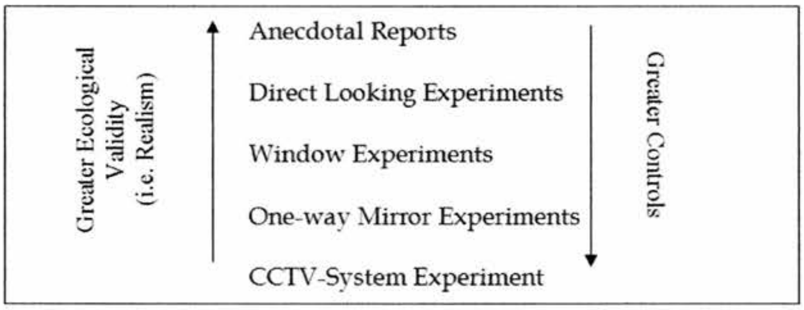

Figure 3.1: Continuum of remote staring detection studies (from I. S. Baker, 2005)

It was Sheldrake's (1994) book *"Seven Experiments that could Change the World"* which began his published work into remote staring detection.[9] In this

[9]At a recent conference, Sheldrake and I discussed the research into remote staring detection, and he suggested that he may have been responsible for the resurgence of interest in the topic.

book, he reports several informal experiments he conducted using the direct looking method, and then proceeds to outline how members of the public can experiment with this procedure, as well as several potential experiments for future work (some of which are repeated in his future publications, e.g., Sheldrake, 2005a).

Sheldrake (1998) reports upon his first peer-reviewed experimental work utilising the direct looking method. In this paper, Sheldrake (1998) reports data sent to him by schoolteachers who ran his experiment in Germany and the USA. They found significant effects, suggesting that children could detect remote stares. However, apart from the limitations of this method that will be discussed in more depth later, there is a significant problem in the data in the fact that Sheldrake did not acquire the data himself, but was reliant upon the methodological rigour of teachers and their pupils. There is no way of knowing to what degree the children may have cheated, or been particularly susceptible to subtle sensory cues. These issues are mirrored by Sheldrake's (1999) paper, which suffered from the same issue of not having Sheldrake as the primary experimenter, or even present when the experiments were conducted, but rather being reliant upon others who are largely untrained in experimental methods or the issues surrounding parapsychological studies. Such methods have a certain role in educating members of the public about parapsychology, but should not be reported as rigorous, empirical research.

Some of these concerns are partially addressed in Sheldrake (2000), where Sheldrake acted as the experimenter, although he does also report several experiments where teachers acted as the experimenters. Again, significant results are reported. In addition, an interesting methodological development is also reported as this is the only study to report the window based method, which does help to alleviate some of the issues surrounding possible sensory cueing that could contaminate the direct looking experiment results.

Sheldrake's (2000) paper was then followed by a barrage of studies and debates in 2000 and 2001, in which Sheldrake and his critics discussed his research and potential artefacts that could explain the effects. The first paper was an investigation into the direct looking methodology by R. A. Baker (2000), who was heavily critical of Sheldrake's methods, and the area of research in general. R. A. Baker (2000) reports two studies, in the first experiment under 'real-life' conditions, he stared at the back of the heads of individual's that were sat between

He recalls giving a talk on the topic to William Braud and colleagues at the Mind Science Foundation in 1986, which may have encouraged their interest in exploring this area.

five and 20 feet away from him in different libraries. After staring at them, R. A. Baker (2000) explained the nature of the investigation and then asked them to complete a response sheet concerning whether or not they felt they were being stared at during the last five minutes. R. A. Baker (2000) reports that 35 out of the 40 subjects reported that they had no awareness of anyone looking at them. However, this experiment is poorly controlled, suffering from the same issues that other direct looking experiments have, and there is a poor experimental methodology, with effectively no control condition (i.e., stare vs. no-stare conditions). Although R. A. Baker's (2000) is making a point about the methodological flaws in this type of remote staring detection study, his lack of appropriate methodology and discussion of lab-based studies means that he can be criticised for the very thing he is attempting to critique — poor experiments. The second study that R. A. Baker (2000) reports offers a slightly better methodology. In this study, 50 participants adopted the roles of both starer and staree, and had to attempt to detect a remote stare in a pseudo-randomised order via a one-way mirror. R. A. Baker (2000) fails to report any statistical analysis, but concludes that lack of accuracy would never approach significance. However, as with the first study there are issues surrounding the methodology: the starer had to move in order to stare at the staree, the randomisation sequence is inadequate, and the record sheet requires a graded response of either 'not sure', to 'almost sure' to 'certain', with no indication of how these skewed responses are graded as a measure of remote staring detection in the results.[10] It is unfortunate that in his haste to prove that Sheldrake's methodology is poor and the claims of this area biased that R. A. Baker (2000) falls into the same problem of providing poor and biased research. If R. A. Baker (2000) had paid more attention to the lab-based studies, for all of their potential criticisms, he may developed a superior methodology would would have provided better evidence for his line of argument.

The next study in this debate to tackle Sheldrake's data was Colwell et al. (2000), where they attempted to evaluate Sheldrake's claims under laboratory conditions. Their first study of 12 participants using a one-way mirror found positive results, however Colwell et al. (2000) also found evidence of a response bias (i.e., participants were more likely to say that they thought that they were being stared at remotely) particularly when the participants were given feedback and a lack of adequate randomisation (Colwell et al., employed Sheldrake's randomisation sequences, based on sequences provided by the *New Scientist's*

[10]The results suggest that only the 'certain' responses are rated as an indicator of success, which suggests that the response categories are therefore skewed, as two out of three of the categories will provide an unsuccessful result.

web-site at the time). A second experiment, using an identical set up but with superior randomisation and no feedback, did not find evidence to suggest remote staring detection was occurring. This suggested that there was a problem with some of Sheldrake's experiments, but Colwell et al. (2000) do acknowledge that it does not confound all of his studies, as not all of them utilised feedback. Colwell et al. (2000) also acknowledge that this bias effect "...would not appear to be able to account for the data obtained by Braud et al. (1993a, 1993b), whose research provides the clearest support for the [remote] staring detection effect."(Colwell et al., 2000, p. 84).

After the Colwell et al. (2000) publication, there followed a critique of Sheldrake's work based on the paper which was published in the *Skeptical Inquirer* (Marks & Colwell, 2000). It was at around this time that Sheldrake attempted to answer this barrage of criticism. He began with an article in the *Skeptical Inquirer* replying to both R. A. Baker (2000) and Marks and Colwell (2000). In this article, Sheldrake (2001a) heavily criticises R. A. Baker's (2000) methodology for redefining the criteria for remote staring detection during the first study, for discarding results, for using an unbalanced design and for using confusing instructions. He then proceeds to criticise Colwell et al. (2000) for using a small number of participants, for ignoring the issue that participants should demonstrate implicit learning in *both* staring and no-staring trials, and for changing starers between the two reported studies. He also reiterates that some of his work has used structureless randomisation and lack of feedback (i.e., Sheldrake, 1999).

Sheldrake's (2001a) paper was followed by replies from both R. A. Baker (2001) and Marks and Colwell (2001). R. A. Baker (2001) reply is short and does not address all of Sheldrake's (2001a) criticisms, but he still concludes that "...Sheldrake's attempt to shoot down the results of my two demonstrations has failed completely and I stand firmly with my original conclusion..."(R. A. Baker, 2001, p. 61). Marks and Colwell's (2001) reply is more extensive. They reiterate their criticism that Sheldrake's research is poorly controlled, and maintain that implicit learning is a possibility and as the focus of the task is on detecting a remote stare, then the bias should be in that direction, and that even Sheldrake's more robust research failed to test that the order was structureless, although they fail to comment upon the lab-based research that does not suffer from this issue. They also argue against the issue concerning the change of starer in Colwell et al.'s (2000) experiments, although the potential factors surrounding the effects that the starer brings to these experiments is relatively unexplored, and it is difficult to know what variables need to be controlled.

Sheldrake (2001b) followed on from this discussion and his earlier work in schools. In order to answer some of the criticisms levelled at this line of research by the above authors, he first reports a study he conducted at a school where in one study the participants wore blindfolds, and where the administration of feedback was also manipulated. Sheldrake (2001b) reports significant remote staring detection effects with blindfolds, suggesting that they had little effect, and a non-significant effect of feedback.

Schmidt (2001) neatly summarises some of the biggest criticisms that Sheldrake's work faces. He highlights issues surrounding sensory cuing in the direct looking experiments that are difficult to overcome due to the limitations of the method, and that this could account for at least part of the effect. Schmidt (2001) also comments on the "stacking effect" where participants naturally tend to react in certain patterns, which when combined with Colwell et al.'s (2000) observation on the nature of the randomness of the sequences demonstrates greater ambiguity of Sheldrake's effects. Possibly the most important practical observation that Schmidt (2001) makes of Sheldrake's work is that all of his research is conducted in the field, often with young participants, which has huge implications for the maintenance of experimental controls.

Sheldrake's work into remote staring detection has thus far culminated in a special issue of the *Journal of Consciousness Studies*, in which he summarised his, and others, findings (Sheldrake, 2005a), and suggested a possible mechanism based on extramission theory (Sheldrake, 2005b). These papers were commented upon by 14 critics, and Sheldrake (2005c) responded to these comments. In the summary of his work, Sheldrake (2005a) provided a crude analysis of his remote staring detection studies to date (Sheldrake, 1998, 1999, 2000, 2001a, 2002), and concluded that there was a highly significant effect ($p = 1 \times 10^{-20}$, Sheldrake, 2005a, p. 15). Radin's (2005) somewhat more structured preliminary meta-analysis reported in the issue suggested a slightly more "conservative" value ($p = 5 \times 10^{-17}$, Radin, 2005, p. 95).

However, my (I. S. Baker, 2005) criticisms of Sheldrake's research, mentioned at the beginning of this section, have implications for evaluating this large body of material and for understanding the field of remote staring detection research as a whole. These criticisms centre around two main points: (a) issues of ecological validity, and (b) the issue of whether or not the lab-based studies that used EDA and CCTV measures can be directly compared to the direct looking experiments.

The first issue of ecological validity is integral to understanding the remote staring detection studies. I have suggested (I. S. Baker, 2005) that there are two subtly different elements to this. The first is *realism*, "...which refers to how closely a particular method recreates the phenomenon one assumes happens in 'real life' " (p. 58), and the second is *generalisability*, which refers to the question of "...can the data obtained from a particular method be generalised to the real life phenomenon that the experiment is attempting to measure?" (I. S. Baker, 2005, p. 58).

With regard to realism, I defined (I. S. Baker, 2005) a continuum of different methodologies used in remote staring detection studies, which was outlined in figure 3.1 on page 53. This continuum represents the methodological development and increasing sophistication of the remote staring detection studies over the past 100 years, although some researchers, particularly Sheldrake, have argued for a return to the more simplistic methodologies. This is specifically because "direct-looking tests are far easier to perform than CCTV trials..." (Sheldrake, 2005a, p. 14), which is true due to the equipment considerations, but he has also argued that, "...[direct looking experiments] are also closer to the real life phenomenon..." (Sheldrake, 2001b, p. 122). This argument is that, as with many experiments, any decrease in the degree of control over extraneous variables results in an increase in ecological validity (as noted in figure 3.1 on page 53). However, I then suggested (I. S. Baker, 2005) that this is not necessarily the case in the lab-based remote staring detection studies. The reliance upon the use of CCTV systems in the lab-based studies offers a greater degree of control, but also due to the dramatic rise of CCTV systems for everyday surveillance in a variety of situations over the past 10 years, suggests that the use of this methodology might have a similar degree of ecological validity to the direct looking experiments, if in a different manner. The dominance of CCTV, particularly in the UK where as of 2003 there it was estimated that there were as many as 4.2 million CCTV cameras, which translates as one camera for every 14 people (McCahill & Norris, 2003, as cited by Norris, McCahill, & Wood, 2004), strongly reinforces the idea that being stared at remotely via a CCTV camera is a disturbingly common experience for many people, and the lab-based studies recreate this everyday experience.

A subtly difference issue is generalisability. I have argued (I. S. Baker, 2005) that Sheldrake (2005a) fails to draw enough of a distinction in the remote staring detection studies between the differences in the use of conscious measures, (i.e., the verbal or written indication of whether or not the staree thinks that are being stare at or not), and the use of unconscious measures, (i.e., the measurement of electrodermal activity during staring and non-staring periods). The issue that I have previously highlighted (I. S. Baker, 2005) is whether or not the measurement of unconscious indicators is less ecologically valid than the use of conscious measures. Although people tend to report conscious awareness of a remote stare in anecdotal reports, the physiological stimulation that is measured in the unconscious measures could most likely act as a precursor to cognitive awareness, which is the rationale that Braud et al. (1993a) use to justify their introduction of the EDA measure:

> "... [remote] staring detection frequently takes the form of spontaneous behavioural and bodily changes. Often, such changes are reported to be rich in physiological content (for example, tingling of the skin, prickling of the neck hairs) and automatic movements (for example, spontaneous head turning, unplanned glances). Higher cognitive functions seem to play minor roles in these [remote] staring detection contexts."
>
> (Braud et al., 1993a, p. 376–377)

Braud et al. (1993a) go on to suggest that the type of conscious guessing methodologies employed by direct looking experiments would potentially maximise the sort of interference and distortions that higher order cognitive functions would impose upon the potentially subtle remote staring-related cues. The measurement of physiological arousal could represent a more ecologically valid measure than the conscious measures that could be 'contaminated' by complex cognitive processing and awareness (i.e., an individual dismissing the sensation because they do not believe in remote staring detection, or vice versa).

The second issue that I have previously drawn attention to (I. S. Baker, 2005) is whether or not the direct looking and the lab-based experiments can be directly compared at all. Since Braud et al.'s (1993a) work, the use of EDA methods, with the controls that are implicit in their use, have often been combined with the greater controls offered by the use of a CCTV system. As has been seen, this combination of EDA and CCTV (or EDA-CCTV as I defined it in I. S. Baker, 2005) involves putting the starer and staree in different rooms, and measuring the EDA of the staree during randomly scheduled epochs when the starer does or does not stare at them via the CCTV system. Schmidt et al. (2004) analysed 15 EDA experiments, *all* of which used the CCTV method, in their meta-analysis and found a small, but significant, effect ($Cohen's\ d = .13, p = .01$) across all of the studies. This result should be treated with some caution due to the methodological issues surrounding the use of EDA in parapsychology (see section 3.5 on page 43), although Schmidt et al. (2004) do incorporate these issues into the evaluation of the studies when conducting the meta-analysis. The size of this effect is important when comparing the EDA-CCTV method with the other methods used in the remote staring detection studies, particularly the use of the direct looking method. Sheldrake (2005a) claims that the direct looking studies have a significance[11] value of $p < 1 \times 10^{-20}$. However, Schmidt et al.'s (2004) analysis of the EDA-CCTV studies suggests a far smaller value which, as I have suggested, indicates that "*... the larger the significance value, the less robust the controls*" (I. S. Baker, 2005, p. 61, emphasis from commentary). I continued on to argue that Sheldrake (2005a) time and time again falls back onto the EDA-CCTV studies in order to bolster the data from his direct looking experiments, because of the superior controls and more robust findings offered by the EDA-CCTV method, but cannot integrate the findings from these studies into his extramission and 'perceptual fields' theory, as he states: "... the way in which they can help explain the effects of staring through CCTV is obscure..." (Sheldrake, 2005b, p. 44). As I concluded, Sheldrake (2005a, 2005b) is:

> "... attempting to have the best of both worlds: he is happy to use the more robust empirical evidence from the EDA-CCTV studies to back up his claims from the direct-looking experiments, but then sidelines the EDA-CCTV studies from his perceptual fields theory because there is difficulty in incorporating them conceptually."
>
> (I. S. Baker, 2005, p. 62–63).

This is not to say that the EDA-CCTV studies do not have their problems. Schmidt and Walach (2000) and Schmidt et al. (2001, 2004) have demonstrated that there are issues surrounding the use of EDA methodology in parapsychological experiments, but the evidence that is suggested from such experiments generally demonstrates far greater control over extraneous variables and relatively similar ecological validity to the type of direct looking experiments that Sheldrake is advocating — experiments that have been largely conducted by teachers with their pupils in uncontrolled environments. As Blackmore (2005) commented on Sheldrake's (2005a) paper: "[Sheldrake] gives detailed results of some highly flawed studies but then gives only a cursory description of experiments [i.e., EDA-CCTV] that would, if valid, be very impressive." (Blackmore, 2005, p. 65).

[11] As I have argued (I. S. Baker, 2005), it would have been very useful if Sheldrake (2005a) had provided an overall effect size, and a detailed rationale and description of the process of calculation of this statistic.

3.5.4 Theories of remote staring detection

'Paranormal' phenomena are difficult to define, and therefore it is also difficult to theorise about the nature of how they are caused and how they might work. One of the main difficulties is that phenomena observed in parapsychology studies are often defined in a terms of a subtraction. By controlling for all potential artefacts, if a significant effect is noted at the end of an experiment, then this value 'x' is interpreted in terms of a potentially 'paranormal' effect, and its theoretical foundation is often determined by the design of the experiment. The most stringent meta-analysis of the best controlled examples of the remote staring detection studies (i.e., the EDA-CCTV studies) suggests that "...there is some hint of an anomalous effect in the data..." (Schmidt et al., 2004, p. 245). If remote staring detection is a 'genuine' phenomenon, i.e., the effects observed are not due to uncontrolled or unaccounted extraneous variables, then it should be possible to theorise about its nature, although considerably more research needs to be conducted to understand its nature.

Titchener (1898) suggested that remote staring detection is due to nervousness resulting in individuals turning around, and the act of turning prompts the 'starer' to look at them. This, presumably combined with selectively recalling the instances when one turns around and finds another looking at them, and not recalling when no one was looking, could explain the effect. However, this would only explain anecdotal reports, and possibly some of the direct looking experiments, but could not explain the data from the EDA-CCTV experiments.

Braud has suggested in several publications (Braud et al., 1993a, 1993b; Braud, 2005) that *attention* or *intention* is involved in the remote staring detection process, and it is moderated by the beliefs and/or training of the starer (as they found that 'connectedness' training reduced the EDA of staree's when they were being stared at remotely, as opposed to the expected increase). Schwartz and Russek (1999) attempted to test this idea by comparing remote staring detection with an 'intent' to stare, but with the starer's eyes closed. The did not find a significant difference. However, this may have been due to their use of a poorly controlled procedure centred around the direct looking method, and the possibility that the intent to stare, and the remote stare itself, may represent similar processes and therefore there was effectively no control condition to compare against. The implicit suggestion with the concept of intent is that the remote staring detection effect is therefore starer-oriented, although Braud (2003) places it firmly within the DMILS framework which does not assume directionality.

DMILS is a useful term in which to subtly distinguish the methods outlined here from other areas of parapsychology, such as telepathy or psychokinesis research, but it is ultimately of limited use as a theoretical construct. It essentially refers to some kind of "mental interaction between two living systems", which demonstrates a lack of theoretical underpinning as, it is vague, it does not define the nature of this interaction in any way, and it fails to propose a testable hypothesis concerning its mechanism. It does not clearly distinguish itself from other areas of parapsychology that could also be potentially encompassed by this very broad definition, but by convention in the literature are not. It is potentially more productive to rely upon a description of the methodology being used, such as remote staring detection, even if this is eventually proved inaccurate.

Wiseman and Schlitz (1997, 1999) suggest that the experimenter is also acting as an interactive element in the experiment, possibly not only in a conventional sense, but also in the form of experimenter psi (J. Palmer, 1997). However, as the experimenter also acted as the starer, and due to the lack of significant findings in the Schlitz et al. (in press) paper, and in experimenter/starer manipulations reported by Lobach and Bierman (2004), this is inconclusive.

Sheldrake (2005a) suggests a theory of remote staring detection that has its foundations in extramission theory and 'perceptual fields' — similar to his ideas of morphic reasonance (i.e., Sheldrake, 1981, 1988, 2003) — and it is directional, "...an influence seems to pass from the observer to the observed ..."(Sheldrake, 2005b, p. 32). In summary, intromission theories of vision are the dominant theoretical construct of how vision works, based on Kepler's work in 1604 (S. E. Palmer, 1999), that light is reflected from an object and enters the eye. In contrast, extramission theories suggest that "... vision involve[s] emissions from the eye..." (Cottrell et al., 1996, p. 50). Sheldrake (2005b) embeds his explanation of remote staring detection into the extramission theories of vision. Aside from the debates about the nature of paradigm shifts in science, and the scientific validity of intromission and extromission theory, as both issues have been commented on extensively by others (e.g., Blackmore, 2005; Clarke, 2005; Carpenter, 2005; Ellis, 2005; Velmans, 2005), Sheldrake (2005b) appears to ignore some of the fundamental findings of Cottrell et al.'s (1996) exploration of belief in extramission and remote staring detection. Cottrell et al. (1996) found evidence that suggested that extramission belief and belief in remote staring detection are two separate constructs of belief. This means that people do not intrinsically believe that some kind of "rays" shoot out of the eyes of the starer and the staree becomes aware of the remote stare due to these rays. It ultimately becomes unnecessary to attempt to tie in extramission theory, and it undoubtedly harms Sheldrake's (2005b) argument to do so.

Sheldrake (2005b) theory of perceptual fields continues on to draw analogues to electromagnetic fields, although they influence probablisitic processes, and suggests that they "...bind together and coordinate patterns of activity into a wider whole." (Sheldrake, 2005b, p. 43). Sheldrake (2005b) suggests that these fields have three main properties of interest: (a) they could connect activity from different parts of the brain and could therefore represent a solution to the *binding problem*[12], (b) they contain attractors which give meaning to the system as a whole and can therefore explain the intentionality of perception, and (c) they link together the starer and staree as they extend beyond the brain.

Sheldrake (2005b) then relates these fields to the work on quantum systems and quantum entanglement, a set of theories that has already fascinated parapsychologists, and some researchers suggest that it might be able to explain certain phenomena currently identified as "paranormal" (see Walach, Schneider, & Chez, 2003, for a discussion of this issue). By tying his theory in with this line of research, it begins to encounter the same issues that surround quantum entanglement. As Clarke (2005) argues in his commentary on Sheldrake's (2005b) paper, there is the issue of how information is transmitted between the starer and the staree if it involves quantum entanglement, as "...none of the quantum mechanical theories cited by Sheldrake overcome this problem of the direction of information flow..." (Clarke, 2005, p. 80), as such theories dictate that information is not transmitted. It also requires other questions to be answered: such as how can these fields be measured? And how does the linkage between the starer and staree start and end?

In addition to this, as I have previously commented (I. S. Baker, 2005), Sheldrake (2005b) himself notes that the EDA-CCTV studies, which he relies upon to justify the shortcomings of the direct looking experiments, do not fit within this theory: "...the way in which they [i.e., perceptual fields] can help explain the effects of staring through CCTV is obscure" (Sheldrake, 2005b, p. 44).

Attempting to theorise about the nature of remote staring detection is always going to be fraught with difficulties. For example, due to the nature of the experimental methodology of the remote staring detection experiments, there is

[12]This is an important issue in neuroscience and philosophy concerning how the activities of distributed groups of neurons and areas of the brain "bind" together to give rise to conscious thought.

the suggestion that the starer affects the staree. However, the staree could be actively monitoring their environment for stares (regardless of whether or not they are conventional or remote in origin), or stare-like stimuli. Eyes have been consistently identified as as important stimuli from analysis of cognitive (e.g., Baron-Cohen, 1995), neuroscientific (e.g., Perrett, Hietanen, Oram, & Benson, 1992; Watanabe, Kensaku, & Ryusuke, 2002) and social perspectives (e.g., Argyle & Cook, 1976; Kleinke, 1986). There is the possibility that the same processes that are responsible for processing eyes and staring behaviour from conventional stimuli may also be related to the processing of a similar type of information from a remote stare, and if the information is being received by the staree (although it is unclear how), then it should hopefully be processed by the brain at some point. If it is possible to locate and understand the processing of this information in the brain, then it might be possible to backtrack up the 'system' and understand how the information is received/transmitted/transferred in the first place.

In addition to this, the emotional states of the starer (and staree) may also prove to be important variables, just as they are in more conventional interactions. One of the theoretical obstacles that remote staring detection must overcome is the issue of *restriction of response*. Due to the complex social environments that we find ourselves in, we are exposed to the stares of others, both normal and remote, hundreds of times a day, even more so when the issue of CCTV observation is incorporated into this (I. S. Baker, 2005). Therefore, there must be a process that restricts the responses to remote staring detection, and optimises the response to a particular remote stare so that it enters into conscious awareness, if it occurs in real-life. If this is a threshold effect, then there might be a physiological reaction to a considerable number of remote stares, but we are forced to disregard most of this information as we would otherwise be continually overwhelmed and anxious. However, if we respond to remote stares which contain certain information, such as the emotional content that we would optimally respond to from conventional stares (Ellsworth et al., 1972; Argyle & Cook, 1976), then only these remote stares would potentially rise above the threshold and into conscious awareness. The manipulation of remote staring detection might be isolated and extraneous variables controlled for under laboratory conditions, but if the processing of this phenomenon is present in our everyday lives then it must compete for attentional resources just like any other sensory process. Understanding the relationships between brain-states and remote staring detection could be the first step in being able to propose more robust theories on the nature of the phenomenon.

Finally, the obstacles for theory generation are made even more difficult by the differences between the EDA-CCTV and direct looking experiments. The linear relationship in belief suggested in section 2.3 on page 12, the methodological differences, the differences in the overall findings, and the difficulty in theoretical integration suggest that the EDA-CCTV (particularly the CCTV element) studies, as I have previously noted (I. S. Baker, 2005), may represent remote staring detection under the best, most well-controlled circumstances, or they may represent a completely different phenomenon to that observed under the direct looking experiments.

3.6 Summary

One of the most interesting elements of remote staring detection is its relevance to everyday experience. Although, as has been asserted, anecdotal reports of experiences of remote staring detection are highly problematic as examples of the phenomenon, they do represent the dominance of the experience and the belief, and underscore the importance of studying this phenomenon under controlled conditions.

Remote staring detection represents a promising and fascinating area of parapsychological research that could easily be seen as representing a classification of research in its own right, and does not necessarily need to be subsumed into a sub-type of DMILS research. Belief in this phenomenon is complex, and goes beyond merely asking people if they have experienced it or believe in it. As demonstrated in the last chapter, there is a significant decline in the rating of belief in remote staring detection with the increase of the degree of barriers that are placed between the starer and staree, and yet the lab-based studies that use the most extreme of these barriers appear to demonstrate the most methodologically rigorous effects.

The development of methodological rigour in these studies can be seen as representing the evolution of parapsychology in microcosm: A constant struggle for control over possible extraneous variables, but not at the cost of the ecological validity of the study, the constant debate, and the possibility of contributing findings and methodological points to other areas of research.

However, there have also been considerable challenges faced within the area. Sheldrake (2005c) continues to argue that the direct looking methods he advocates have a place within the struggle to understand this phenomenon. There have also been significant challenges to the way that the EDA studies have been conducted, and a greater appreciation of these issues have already started to find their way into the most recent studies (e.g., Lobach & Bierman, 2004; Schlitz et al., in press).

The spectre of the skeptic-believer dichotomy continues to raise its weary head in the form of the "experimenter effect" as a possible cure for parapsychology's ills, but ultimately promises little in explanatory power due to the huge number of potential variables that it could cover.

Ultimately, remote staring detection could represent one of the most fruitful areas of parapsychology, for its findings, methodological development, and development of potentially testable theories. But it is time to start asking new questions.

3.6.1 The future of remote staring detection research

It is possible that researchers could continue on with the current path of remote staring research, but with the "...hints of an effect..." suggested by the stringent meta-analysis conducted by Schmidt et al. (2004, p. 235), it is time to begin to build upon the methods and findings from throughout this chapter. Firstly, it is essential that any future EDA research employ the methods advocated throughout this chapter (i.e., Fowles et al., 1981; Schmidt & Walach, 2000; Schmidt et al., 2001). Secondly, future remote staring studies need to utilise an automated CCTV system set-up, controlled by computer, as too many of the previous studies have relied upon the starer turning around or avoiding looking at the camera feed. Thirdly, future studies should attempt to examine if there are actually two separate phenomena — represented by the direct looking and the EDA-CCTV studies — that are classed as "remote staring detection", as this could have an important impact upon the generation of testable theories explaining the phenomenon. It is also important to understand whether either aspect of the phenomenon is 'genuine' and not some kind of unknown experimental artefact.

Finally, it is important to examine the possible relationship between the processing of a remote stare, and more conventional stares, and how both are processed in the brain. Hopefully, a remote stare would be processed by the brain at some point and this processing might prove to be similar to, or entwined with, the processing of more conventional stimuli. Due to the type of format the EDA-CCTV method takes, with all of its prerequisite controls, the use of electroencephalographic (EEG) methods would be well suited to this task. EEG methods have never been used to study remote staring detection, but they have been used in other areas of parapsychology. The next chapter will cover elements of their use in parapsychology and the technical considerations for this complex psychophysiological measure.

Chapter 4

Electroencephalagraphy and Parapsychology

4.1 Introduction

4.1.1 Hans Berger

The *electroencephalogram* (or *EEG*) is one of the oldest methods of measuring brain activity that is in use today, and has seen considerable development over its 70 year history, although the basic underlying technology and its principles have remained largely unchanged over this time. The father of the EEG was the researcher Hans Berger and understanding his motivations for developing the EEG is important for placing the method in its relevant context. Berger was born in 1873 in Northern Bavaria, and raised in a family that valued both the understanding of the body (his father was a physician), and of the mind (his grandfather was the poet Friedrich Rückert). In 1892, Berger enrolled at the University of Berlin to study Astronomy, but in 1893 he volunteered for service in the German Army, where he was to have an experience that would impact on the rest of his life.

During a military exercise, he fell off his horse into the path of a mounted gun battery which subsequently only just managed to stop from crushing him. In the evening of that day he received a telegram from his father who was concerned about his well being, which was the only time in his life he ever received such a query. His sister had told their parents earlier that day that she was sure that he had been involved in an accident. He concluded from this event that,

> "This is a case of spontaneous telepathy in which at a time of mortal danger, and as I contemplated certain death, I transmitted

> my thoughts, while my sister, who was particularly close to me, acted as the receiver."
>
> (Berger, 1940, cited by Gloor, 1969, p. 3)

It was the impact of this event that then prompted Berger to abandon his studies into Astronomy after his military service and to study Medicine in an effort to understand this phenomenon in more depth (Millett, 2001). It was this pursuit that eventually led him to build and develop the EEG, an achievement that was unique in the fact that it was not the result of a collaboration of researchers, but due to his own efforts: "There can be no doubt but that Berger was the sole creator of electroencephalography. He let nobody into the secret of his investigation. What he achieved, he achieved by his individual effort" (Ginzberg, 1949, cited by Millett, 2001, p. 536).

Interestingly, although some researchers have claimed that Berger became heavily opposed to the idea that EEG could be used to explain telepathic function (e.g., Gloor, 1969), the final paragraph of his famous 14 reports, *"On the Electroencephalogram of Man"*, suggest a subtly different conclusion:

> "It is out of the question that the α-w and β-w of my E.E.G. exert any effect at a distance; they cannot be transmitted through space. Upon the advice of experienced electrophyicists, I have refrained from any attempt to observe possible distant effects."
>
> (Berger, 1929-1938/1969, p. 320)

Berger does indeed argue against the use of EEG to investigate any 'effect at a distance', but this appears to be based upon the advice of others. It is understandable that Berger would follow such advice, especially considering the difficulties that he experienced in obtaining credibility for the EEG throughout his career (Millett, 2001) — he would not want to risk such a hard-won reputation on perusing such an unorthodox line of questioning. But, it would have been fascinating to have seen how Berger would have approached such a problem, and its impact upon the method and findings in the field of contemporary parapsychology.

However, Berger was not the only researcher who was interested in the question of 'effect at a distance', and there have been several lines of research investigating parapsychological themes with EEG.

4.1.2 Research in parapsychology using EEG

EEG has been used in parapsychology from the early 1950s to the present day, and different authors have provided reviewed focussing on different aspects or question highlighted in the research (see Beloff, 1974; Morris, 1977; Millar, 1979b; Alexander, 2002; Wackermann, 2004; Charman, 2006). The research can be divided into two main categories, with certain studies sharing characteristics of the two. The first category concerns research where EEG was employed as a *correlate* of a particular 'psi' task, and this can be divided again into *frequency-based methods*, and *event-related methods* (e.g., *event related potentials*, or ERPs) of analysis. These methods typically involve giving individuals a task in order to test a particular aspect of psi ability, and measuring a certain index of brain activity during the task completion using the EEG. Within the experiments utilising the frequency domain several areas have been investigated, including research examining EEG complexity (e.g., Tart, 1963). However, the main focus by far was on alpha (α) band activity and its potential relationship with 'psi'. Much of this research was conducted during the 1960s and 70s, which coincides with the focus on alpha activity as a potential underpinning of consciousness (see Shaw, 2003, for an extensive review on alpha band research from a non-parapsychological perspective). However, this line of research only demonstrated intermittent success and the interpretive strength of the studies are plagued by issues, such as the natural dominance of alpha activity during the relaxed conditions often desired in parapsychology studies. Without locking alpha activity to discrete stimuli and being able to evaluate the effects on alpha activity when the stimuli are manipulated, it is difficult to discriminate changes in alpha activity from background electrophysiological processes.

The amount of research examining event-related correlates of psi tasks has been smaller than the frequency-based material. There was some research examining *contingent negative variation*[1] (CNV) effects (e.g., Hartwell, 1978), which has been criticised (Millar, 1979), but there has been more research examining success on gambling tasks between the processing of targets versus non-targets (Warren, McDonough, & Don, 1992; Don, McDonough, & Warren, 1998; McDonough, Don, & Warren, 2002). There are obvious parallels between these measures and the measurement of correlated brain-states (i.e., the event-related element of a "transferred potential"). However, the main difference is that these studies do not attempt to assess any potential correlations in

[1]Defined as "...a slow, surface-negative electrical brainwave studied in experiments which emphasise the association (contingency) of two successive stimuli" (Hartwell, 1978, p. 83).

brain activity between two individuals, unlike those studies presented below, but instead focus on changes in processing different stimuli in a single person.

The second main category covers those studies that attempted to examine *correlations in brain-states* between the EEG recordings of two individuals. These studies have also been referred to as examining "transferred potentials" (e.g., Grinberg-Zylberbaum, Delaflor, Attie, & Goswami, 1994), ostensibly based upon the suggestion that the event-related activity from one person is somehow being transferred to the other individual. However, Wackermann (2004) strongly argues against the use of this term, as evoked potential-like waveforms have never been observed in the unstimulated subject, and the term also suggests a causal effect for which there is no evidence for at present. Wackermann (2004) advocates the use of the term "dyadic correlations" (p. 105) to highlight the possibility of correlations between the brain-states of two individuals, but without presupposing a particular theoretical framework. Examining potential correlations between the brain activity of two individuals is obviously fraught with difficulty, not only due to the risk of spurious correlations (May, Spottiswoode, & Faith, 2001), but also due to the theoretical considerations. Grinberg-Zylberbaum, Delaflor, Sanchez-Arellano, Guevara, and Perez (1992) and Grinberg-Zylberbaum et al. (1994) added to this controversy by introducing the *Einstein-Podolsky-Rosen (EPR) Paradox* into the fray as a potential mechanism — essentially suggesting that these effects might be due to non-local quantum-level interactions between two brains. More recent research has veered away from specifically testing this hypothesis, but is still reporting some interesting results that could be potentially relevant to understanding it further (e.g., Wackermann, Seiter, Keibel, & Walach, 2003; Kittenis, Caryl, & Stevens, 2004). Walach and Schmidt (2005) have suggested that such non-local explanations could tentatively provide a general framework to begin to understand these potential correlations in brain-states that are being measured in controlled experimental settings. As the experimental research presented in this thesis was examining the responses of only the staree's electrocortical processing and not the starer's brain activity, it does not clearly fit into this class of study. This does not preclude the possibility of dyadic correlations in brain-states between the starer and the staree occurring — they were just not explicitly tested for.

There are a handful of studies that are directly relevant to the research presented in this thesis, because they share characteristics with the use of EEG to investigate remote staring detection. The first set of studies come from the first category of studies outlined above, specifically the use of event-related measures as a correlate of psi performance. In this series of studies, participants performed a forced-choice precognition task where they were asked to guess which one out of four possible images was the randomly selected target image (Warren et al., 1992; Don et al., 1998; McDonough et al., 2002). The ERPs for the processing of the target images were then compared with ERPs for the non-target images. This design would initially appear to demonstrate similar characteristics to the research presented in this thesis (see Chapters 6, 7, and 8). However, these studies are considerably different. Firstly, these studies are designed to examine forced-choice precognition, whereas the studies conducted for this thesis did not incorporate any conscious guessing, nor any overt precognition. Although precognition could have occurred in the studies conducted for this thesis, the design of the experiments were more analogous to experimental designs testing for telepathy or DMILS, although the nature of the potential mechanism remains unclear. The ERP studies presented above also have certain methodological issues. For example, the McDonough et al. (2002) study recorded data from 19 EEG electrode sites, and yet the analysis was conducted on only 12 of these sites, with no justification of why seven sites were ignored. In addition to this, the task relied upon participants providing conscious guesses, which then provides a problem with regard to the ecological validity of attempting to analyse the processing targets when the conscious guesses were incorrect. McDonough et al. (2002) do not treat the processing for the correct guesses any differently from the incorrect guesses. This issue is compounded further by the fact that they also provided feedback to participants on their performance as the study progressed. Some researchers have criticised providing feedback on progress to participants as it is possible that participants can then learn the randomisation sequence (Colwell et al., 2000), although it would appear unlikely in this case as each selection involves four possible options and the conscious guesses were at chance levels. Interestingly, McDonough et al. (2002) do comment on some of these limitations. In the first instance they comment on the potential for artefacts arising from the participant having to choose one target out of a possible four stimuli, and suggest that "...an experimental task which used only two choice stimuli on each trial, one target and one nontarget, would avoid this whole class of problems." (McDonough et al., 2002, p. 202). They continue with the comment that "...a task which did not require subjects to [consciously] guess the target would also make interpretations more straightforward..." (p. 202). The research presented in this thesis incorporates both of these suggestions.

The other study which shares parallels with the research presented in this thesis was conducted by Radin (2003). In this study, the EEG and EDA activity was recorded from 13 pairs of individuals, where one was the 'sender' and the other was a 'receiver'. At random intervals, a live video image of the receiver was displayed upon the sender's monitor, and a randomised permutation analysis was conducted in order to see if there was a significant correlation between the brain activity of both of the participants. Radin's (2003) study does have similarities to the studies presented in this thesis, but also significant differences. Firstly, Radin (2003) only measured data from a single electrode — the studies conducted for this thesis used 40 EEG electrodes for each participant giving a radically more complete perspective on the global electrocortical processing of the stimuli. Secondly, Radin (2003) was attempting to examining autocorrelations in brain functioning between two participants, whereas the studies in this thesis were attempting to understand the impact of remote staring detection upon the electrocortical processing of other, more conventional stimuli, within the brain of a single person, which reflects considerably different theoretical underpinnings. Finally, as a methodological point, Radin (2003) employed a video camera that switched on and off, whereas the studies presented in the experimental chapters used a masking of the video feed to prevent any cueing to the participant that the video camera was changing state.

As can be seen, although the studies summarised above do share characteristics with the research presented in this thesis, the research presented here is ultimately significantly different, both in terms of the underlying theory and in their methodological practice. Therefore, the research conducted for this thesis represents a considerably different methodological and conceptual framework compared to previous parapsychological research that has employed EEG methods. Because of the unique nature of the studies conducted for this thesis it is important to explain why EEG is a useful and justified method for exploring remote staring detection, and what major issues surround its use to examine this phenomenon.

4.2 The use of EEG to examine remote staring detection

It is possible that a technique that measures electrocortical processing (such as EEG), as opposed to methods of measuring peripheral nervous system activity (like EDA), could offer a superior measurement and methodology for assessing the detection and processing of a remote stare. Before directly comparing the measurement of EDA and EEG, it is necessary to provide an introduction into what EEG actually is. Due to the long history and extensive usage of EEG in both clinical and research applications, it would be impractical in the extreme to attempt to provide an in-depth summary of such an immense body of research. Instead, what follows is a basic introduction to core principles of EEG, and a greater elaboration of some of the issues concerning EEG and their direct bearing upon the issue of using EEG to investigate remote staring detection.

4.2.1 EEG and analysis

> "Scientists are now so accustomed to... EEG correlations with brain state that they may forget just how remarkable they are. The scalp EEG provides very large-scale and robust measures of neocortical dynamic function. A single electrode provides estimates of synaptic action averages over tissue masses containing between roughly 100 million and 1 billion neurons."
>
> (Nunez & Srinivasan, 2006, p. 3)

An electroencephalogram involves the measurement of electrical activity from the surface of the cerebral cortex. The cerebral cortex is the 2–3 mm outer layer of the cerebrum, and it has a total surface area of approximately 1600 cm^2, comprising of 10^{10} neurons. These neurons are highly interconnected, with a single neuron in the cerebral cortex having between 10^3 to 10^5 synapses (Nunez, 1981). The electrical activity from the cortex is typically measured non-invasively by placing a series of electrodes on the surface of the scalp, generally forming a connection between the two with the use of a pH balanced saline fluid. The electrodes are normally placed in an array formation corresponding to the standardised 10–20 System devised by Jasper (1958), which broadly corresponds to different areas of the cortex.[2] These arrays can be extensive — the maximum of 256 electrodes is standard, but some of the latest systems can theoretically go up to 512 electrodes (Neuroscan, 2006). The output of the electrodes is amplified

[2]This system is referred to as "10–20" because it represents 10 and 20 percent deviations from four anatomic landmarks, the two most important being the *nasion* (bridge of the nose) and *inion* (bump at the back of the head, just above the neck). The electrodes are then referenced according to anterior–posterior location (i.e., F = frontal, P = parietal, C = central, T = temporal, and O = occipital) and hemispheric location (i.e., odd numbers = left hemisphere, z = midline, and even numbers = midline) (Ray, 1990). Therefore "Cz" refers to an electrode placed in the centre and on the top of the head, and "T6" refers to an electrode placed in the temporal region on the right side of the head.

and typically recorded by computer for off-line analysis, which is a significant advantage over earlier, non-digital systems.

The recording itself is represented by a series of waveforms corresponding to the electrical brain activity underneath the electrode site, and the waveform propagation of generators of particular EEG patterns situated throughout the cerebral cortex, and certain other areas of the brain (Nunez, 1981). For example, it has been suggested for several years that the thalamus, part of the diencephalon, serves as the electrocortical regulator of EEG signals, and therefore its activity can be extrapolated in the EEG recording (Ray, 1990). The amplitude of the EEG signal is measured in microvolts ($1\ \mu V = 1 \times 10^{-6}$ Volts) from the surface of the scalp, and is typically around 100 μV depending upon the activity the individual is engaged in. The skull itself acts a spatial low-pass filter, and EEG is far higher in scale when measured directly from the surface of the brain, when it is around 1–2 millivolts ($1\ mV = 1 \times 10^{-3}$ Volts) (Nunez, 1981). EEG is measured as the difference in potential between the recording site(s) and the reference site(s), which is generally the most cortically inactive site on the body which is feasible, commonly the ears or mastoids. The choice of a reference site is a significant issue, as its location has consequences for introducing additional artefacts into the recording, and different locations can alter the properties of the scalp topography of the EEG and other, event-related measures (Davidson, Jackson, & Larson, 2000; Nunez & Srinivasan, 2006).[3] EEG equipment and amplification is obviously very sensitive and artefacts are a constant issue. The main artefacts are due to muscle activity, eye activity, and non-biological artefacts, such as electrical fields generated by the mains AC electrical supply, which generates a prominent 50Hz frequency in the U.K. However, there are ways that these artefacts can be controlled for and filtered out of the recording (Croft & Barry, 2000; Davidson et al., 2000).

The current theory of what EEG actually represents is "...inhibitory and excitatory postsynaptic potentials of pyramidal cells generated by the cortex of the brain." (Fisch, 1999, p. 4). These pyramid cells represent between two-thirds and three-quarters of all cortical neurons (Nunez, 1981). In order for the activity produced from these neurons to be detected by the relatively gross-level electrodes on the scalp, tens of thousands of these cells need to be in alignment with one another. Essentially they need to be pointing in the same direction either towards or away from the electrode, not parallel to it, and in the

[3] Global Field Power, which is summarised in section 4.2.1.3 on page 83, was suggested for use in evaluating event-related measures for this very reason, as it is reference independent and therefore not subject to this problem (Lehmann & Skrandies, 1980).

same direction as one another so they do not cancel out each other's activity. In addition to this, they also need to be firing in phase with one another, otherwise their summated activity would not be strong enough to be detected by the EEG equipment. Evidently, the activity produced by these groups of neurons is highly complex, and it needs to be sampled at a high rate in order to be captured accurately. Depending upon the clinical or experimental requirements, the EEG from all of the electrodes in usually sampled at between 250Hz and 500Hz, with some brainstem studies requiring sampling at 1000Hz. This highlights the main advantage and disadvantage of EEG over other techniques, such as *functional Magnetic Resonance Imaging* (fMRI). EEG provides excellent temporal resolution, as it can be sampled in the millisecond domain compared to activity over seconds as with fMRI, but the issues surrounding the distributed electrode arrays and the waveform diffusion that the skull provides means that it is impossible to obtain the spatial accuracy that fMRI offers (Davidson et al., 2000).

In summary, EEG is a comparatively inexpensive and typically non-invasive method of recording electrical brain activity from participants in real-time. Although there are many issues surrounding the accurate measurement and analysis of this complex and multidimensional data, the information it provides on the processing of stimuli, particularly in terms of its temporal characteristics, is second to none and it remains a relevant and informative technique some 70 years after its conception.

However, this only covers the basics of what the electroencephalogram is. The main information that EEG provides is when it is analysed in terms of the processing characteristics of certain stimuli, generally divided into frequency-related information and event-related potentials. These analysis methods have their own issues surrounding them, and they are explored in more depth below. By using these different methods in unison a great deal of information on the electrocortical processing of stimuli can be garnered.

4.2.1.1 Frequency analysis

One of the fundamental properties of the EEG, and indeed any waveform, is that it is comprised of a frequency or several frequencies of activity. The dominant frequency of an EEG wave can often be visually inspected, which is commonly done in certain clinical applications. This was how the first frequency characteristics of EEG were discerned by Hans Berger, and the primary way that EEG was analysed until the dominance of digital systems and the advent of computing power which provided more advanced means of analysing the EEG.

In the research domain it is common to utilise algorithms, such as the *Fast-Fourier Transform* (FFT), that can break down the EEG signal from each electrode into the activity of the different frequency bands of interest for a pre-specified period of time. It is then possible to compare the frequencies related to the processing of different stimuli in order to see if they are processed significantly differently from one another. A technical consideration for the use of FFTs in calculating frequency is that they require datasets (i.e., datapoints) to be sampled in powers of 2 (i.e., 128, 256, 512, 1024, etc), or transformed to this using an autocovariance function (e.g., spline fitting) (Porges & Bohrer, 1990). This, combined with the *Nyquist criterion* that states that the detectable frequency in any dataset is equivalent to approximately half of its sample frequency (Nunez & Srinivasan, 2006), places limitations on the FFT analysis. Therefore, if an EEG recording is sampled at 500Hz, and transformed to 256Hz (datapoints per second), the Nyquist criterion would state that only frequencies up to approximately 128Hz can be analysed. As can be seen below, this is rarely an issue when discussing the main frequency bands, but can be an issue for certain types of gamma-band analysis. It also means that the FFTs can only realistically be used to analyse data down to one second epochs, as lower than this would result in the limit of the highest frequency than can be analysed being within the main frequency bands of interest.

The analysis of frequency is a relatively gross measure when compared to the temporal accuracy offered by other measures, particularly the event-related measures such as ERPs. However, whereas ERPs destabilise after a limited amount of time and are prone to more artefact effects, frequency analysis can provide information on processing over several seconds, up to minutes or hours (or even days, in certain applications).

The typical activity of the EEG has been divided into different frequency bands, based upon Berger's work in understanding the characteristics of the alpha and beta waves. A common misconception of the frequency of EEG is that there is only one frequency present, whereas any FFT on EEG activity will confirm that there are several different frequencies present, but at differing ratios depending upon the activity the individual is engaged in, with one frequency being dominant. Additionally, there are usually multiple generators of a particular frequency within (and without) the cortex. It should also be noted that the frequency of brain activity is negatively correlated with its amplitude, so that lower frequencies have far higher amplitudes of activity. This is because "with an increasing number of interconnecting neurons and therewith an increasing number of coherently activated neurons, the amplitude increases and the frequency decreases." (Pfurtscheller & Lopes da Silva, 1999, p. 1843). This is reflected both within and between frequency bands.

To a certain extent, all subdivisions of EEG frequency into separate bands are arbitrary, but there are common ways in which EEG frequency has been separated and this is described in more detail below.

Delta activity (δ): This band of activity was named by Walter (1937, as cited by Ray, 1990), and is represented by very low frequency activity (0.5–4Hz). It is generally only present during certain non-REM stages of sleep, and it is also the predominant frequency of activity in newborns during the first two years of life (Ray, 1990). Tucker, Dawson, Roth, and Penland (1985, as cited by Ray, 1990) argue that delta activity is also present in the wakeful EEG, but it is not visible like the delta activity that is present during sleep, and can only be detected via FFT analysis. They suggest that this could represent two distinctly different forms of delta activity, both of which could be responsible for different psychophysiological processes.

Theta activity (θ): This band of activity has had relatively little research examining it, particularly in comparison with the other bands. It is characterised by low frequency activity (4–8Hz) and was first discussed by Walter (1953, as cited by Ray, 1990) in the 1940s. He suggested that, whereas alpha activity represents the brain scanning the environment for information, theta activity represents scanning for pleasure, as cessation of pleasurable activity is associated with increased theta activity. Theta activity is also associated with several altered states of consciousness, including: hypnogogic imagery (see Mavromatis, 1991, for an extensive review of this state), rapid eye moment (REM) sleep, and certain forms of meditation, but there is still little understanding of the purpose of this type of activity (Ray, 1990).

Alpha activity (α): This was the first form of EEG discovered by Berger, and is the most well-studied band of EEG activity, and yet the nature of its psychophysiological purpose is still hotly debated (Shaw, 2003). The alpha band of activity is characterised by high amplitude, low frequency waves and typically covers from 8–12Hz, but can be sub-divided. It is measured prominently in the EEG traces of three-quarters of the population when they are awake and relaxed (Shaw, 2003). Because of this, it is an issue in parapsychology experiments, where the individual is often in a relaxed, awake state. The dominance of alpha activity during such tasks makes it a difficult measure to rely upon during state-dependent measurements of 'paranormal' cognition. For example, if an experiment were to conclude that there was less alpha activity during a period when an individual was attempting to remotely view a distant location compared to being relaxed, a decrease in alpha activity might not be due to any unusual types of cognition, but because they were engaged in more active cognition than during a resting state. This is a criticism that can be levelled at many parapsychology studies that have examined frequency based correlates of psi activity.

There is also a burst of alpha activity generated in the occipital areas when the eyes are closed. Alpha activity is generally associated with consciousness and awareness, and its reduction (alpha blocking) is associated with processing sensory stimuli or with mental activity (Shaw, 2003). Shaw's (2003) review of the literature on alpha activity summarises several theories that have been put forward to explain what alpha is responsible for, from attention to arousal, visual information processing, intention, to being the brain's internal 'clock' for scanning the environment for new stimuli.

Beta activity (β): Hans Berger is also credited for discovering and naming this band of EEG activity, although at the time many researchers viewed this low amplitude (2–3 μV), high frequency (13Hz to approximately 30Hz, depending upon definition) activity as being an artefact associated with muscle activity (Shaw, 2003). However, Jasper and Andrews (1938, as cited by Ray, 1990) demonstrated that beta activity was generated in the cortex, and in distinctly different regions than where alpha was generated. Beta activity can be subdivided into Low Beta (13–20Hz) and High Beta (20–30Hz). Beta activity has been associated with the processing of tactile, auditory and emotional stimuli, and the tension associated with increased levels of anxiety (Ray, 1990). Shaw (2003) argues strongly against the "common misunderstanding" (p. 30) that when alpha activity is blocked that it is replaced with beta activity, rather that beta is often present, even when the EEG is dominated by alpha activity.

Gamma activity (γ): This band of activity was discovered and named by Jasper and Andrews (1938, as cited by Shaw, 2003) during their exploration of beta activity. They characterised it as being high amplitude activity 30–50Hz, but it is now often defined from 30–100+Hz. This band of activity was largely ignored for many years, but there is now increasing interest in it (Shaw, 2003). It has been associated with perception and consciousness, and it might also be associated with the 'binding problem', i.e., that it might represent the mechanism by which different activities and regions of the brain are brought together in order to provide conscious perception. Gamma might in some way represent the 'coupling' of processes in order for the brain to perceive something, before rapidly uncoupling for the next cognitive state (Vanderwolf, 2000), but this is hotly debated.

The majority of EEG research focusses on frequencies between 0.5Hz to 40Hz, in order to encompass the majority of the bands of activity summarised above. However, with the introduction of ever-increasingly powerful amplifiers and methods of analysis of complex digital signals, some researchers have advocated the measurement of full-band EEG (FbEEG), examining frequencies from DC up to several hundred Hertz (Vanhatalo, Voipio, & Kaila, 2005). However, there are still some technical issues to be overcome before the analysis of this amount of data becomes common in EEG experiments.

Frequency analysis is a useful measure for understanding remote staring detection because it provides an analysis of the cortical electrophysiological processing of the phenomena over epochs in the second domain. As can be seen in the next section, ERPs are limited to analysing data up to approximately one second, before the event-related data destabilises (depending upon the nature of the stimulus). This longer time period of analysis is complementary to the ERP analysis and is also more comparable to the previous research that used EDA methods, as the stimulus exposure time of such studies was often as long as 30 seconds in duration.

4.2.1.2 Event-related potentials

> "...ERPs are one of the most established methods in cognitive neuroscience and are considered the 'gold standard' in terms of temporal resolution among noninvasive imaging methods"
>
> (Fabiani, Gratton, & Coles, 2000, p. 53)

ERPs are the most common form of analysis of EEG-derived data. ERPs differ significantly from frequency analysis, as they are always tied to the processing of a particular event. Although it is possible to conduct frequency analysis along these lines, such an analysis is usually conducted on the recording of spontaneous EEG activity.

ERPs are regarded conceptually as representing the activity that is associated with specific psychological processes (Coles, Gratton, & Fabiani, 1990). This information is extracted from the raw EEG trace by a process called *averaging*. This involves time-locking the trace to a particular event, which is usually a stimulus presented to the participant, but can also involve a response. This event is then repeated many times, depending upon the specific processing of interest, and the *signal-to-noise ratio* (SNR). The multiple segments of EEG for the processing of this stimulus are then averaged together, with the onset of the event typically representing zero milliseconds. Everything before this point is the prestimulus baseline period, and the resulting waveform after this point represents processing of the individual stimulus. This additive averaging process is represented by the following calculation (taken from Kalcher & Pfurtscheller, 1995):

$$ERP(j) = \frac{1}{N} \sum_{i=1}^{i=N} x(i,j) \tag{4.1}$$

Where N is the total number of trials, and $x_{(i,j)}$ is the j-th sample of the i-th trial of the data. This is then performed for each condition, and for every participant, and then these ERPs are usually averaged together again to represent a *Grand Average* of each condition across *all* participants. Averaging allows the background noise from the EEG to be subtracted out, and the signal associated with the processing of a specific stimulus to be extracted. This assumes that the background EEG varies randomly from sample to sample and therefore should be averaged out. This is vital as the raw EEG is of a very high amplitude (approximately 50 to 100μV) compared to the small effects of the ERPs, which are typically a few microvolts and rarely visible on a raw EEG trace (Coles et al., 1990).

The resulting ERP trace represents a function of voltage $\times$ time, with positive and negative peaks of activity. Such datasets are usually much more complex with the addition of several different experimental conditions and the use of a spatial domain (i.e., the different electrode sites across the scalp in a three-dimensional array). The activity from a single neuron would be tiny if measured from the scalp, and ERP generation is reliant upon the combined activity of a large group of neurons and, due to the comparatively small amplitude of an ERP, this is even more of an important issue than for raw EEG recording in general. In order for this activity to summate, the neurons need to be phase synchronous, and their electric fields need to be in alignment, i.e., as an open field arrangement. An open field is induced when a group of neurons have their dendritic trees oriented on one side, and their axons departing on another, ensuring that the electric fields are oriented in the same direction. A closed field is generated when neurons are concentrically or randomly organised. When in this arrangement, the electric fields will not summate and be detected at the scalp, or may even cancel each other out altogether (Coles et al., 1990). This means that researchers should be cautious in drawing conclusions from ERP data and from making interpretations concerning the underlying cortical physiology. It is possible that a particular stimulus is having an impact upon brain processes, but due to the alignment or phase of the affected neuron clusters, the activity is not summating and is therefore not present in the ERP data (Coles et al., 1990).

Elements of interest, or *components*, in an ERP waveform are often expressed in terms of their latency and their polarity. This is normally demonstrated by terms such as the 'N170', being a negative deflection that peaks at approximately 170ms, or the 'P300', being a positive deflection that peaks at approximately 300ms (Coles et al., 1990). This is further complicated by the abbreviation of such terms, so that and 'N170' can become an 'N1', and a 'P200' can become a 'P2'. Also, different populations of participants rarely demonstrate the exact same latency for a particular form of processing, so there can be variability surrounding the identification of the latency of a particular component from one study to another (Fabiani et al., 2000). Coles et al. (1990) summarise the three main ways in which components of the ERP voltage × time function can be identified. First, the components can be defined in terms of the peaks and troughs (i.e., *maxima* and *minima*) that are observed as part of the ERP trace. Secondly, the components can be defined in terms of aspects of the waveform that are functionally associated, i.e., they covary across participants, across scalp location, or between experimental conditions. Finally, the components can be identified in terms of the neural structures that generate them.

The identification of these components is an important issue in the research presented in this thesis. Because research into the cortical electrophysiology of remote staring detection has never been conducted before, the challenge of the identification of valid ERP components was even greater than that which faces many ERP studies, because it was not possible to refer back to other studies that had previously identified components as a possible benchmark. However, it was possible to use the first two suggested methods for identifying components outlined above. Identifying maxima and minima provides more discrete and easily identifiable components than can be defined by using more ambiguous and arbitrary time-periods. Also, by collapsing the ERP waveforms across participants, across conditions, and across electrodes (via the Global Field Power analysis outlined below) the most conservative identification of maxima and minima was possible, as the components were not driven by a single condition, or the variable measurements of an individual participant or electrode. Finally, as will be seen in the experimental chapters, remote staring detection was assessed experimentally in terms of its impact upon more conventional processing, such as face and object processing, and the components associated with these more conventional processing have been identified in previous studies and therefore could be used as a baseline from which the impact of the remote staring detection could be assessed. The ERP components associated with these forms of processing are discussed in the next chapter.

The main strength of using ERPs to examine the cortical electrophysiology of remote staring detection is that they are regarded as the 'gold standard' of event-related measures. ERPs allow a direct comparison between remote staring detection and other, more conventional processes, and an exploration between the parallels and differences between them. They also provide a mechanism by which the specific processing associated with remote staring detection can be studied in isolation by subtracting out all of the other processing that may be occurring at the same time.

4.2.1.3 Global Field Power

The primary dependent measure for evaluating the event-related potential data in the experimental work in this thesis was *Global Field Power* (GFP). GFP can be used to evaluate several different kinds of EEG data, but here it will be discussed in the context of the analysis of ERP data. GFP is a highly robust measure which differs from single-electrode ERP measures by using the data from *all* of the recording electrodes, and it is also independent of the reference site. The choice of the reference site can significantly alter the properties of the waveforms at individual electrode sites; see Lehmann and Skrandies (1980) and Nunez (1981), and the recent debate concerning research into face perception by Joyce and Rossion (2005) for details. Global Field Power can be expressed as the following (taken from Lehmann & Skrandies, 1980):

$$GFP = \sqrt{\frac{1}{2n}\sum_{i=1}^{n}\sum_{j=1}^{n}(U_i - U_j)^2} \tag{4.2}$$

Which represents the root-mean-square deviations between all electrodes (i.e., for each of the voltages U for an $i \times j$ array of n electrodes) for each time point (based on Skrandies, 1995). Therefore, the GFP can be defined as a reference free measure of "...the mean of all possible potential differences in the field that corresponds to the standard deviation of all recording electrodes with respect to the average reference." (Skrandies, 2002, p. 203). In summary, the GFP measure represents the spatial standard deviation between all electrodes at any time-instant. The GFP is high if the fields (or waveform) have pronounced peaks and troughs, and low where it is flat. When plotted as a function of time, a high GFP value means that there are large deviations in amplitude between electrode sites (as it is a measure of spatial standard deviation), but that this deviation is also relatively stable. When compared with individual electrodes, GFP can be seen to neatly and robustly summarise the main components (e.g., 'P1', 'N200', etc). It is also the primary method for peak identification recommended by the *Society for Psychophysiological Research* (Picton et al., 2000, p. 143). As a function of the calculation (as it is essentially a measure of variance), all values are positive.

Assuming that the effect has some form of global impact, this measure is more robust than selecting individual electrodes. This is not just because it is reference-independent, but because any significant effects from this measure should be demonstrated across a significant area of the scalp, as the measure includes data from all electrodes. This element of enhanced robustness does not, on its own, reveal any clues of the potential location of an effect, but it does provide a stronger argument for a particular effect being present. This conservative approach is obviously essential when suggesting controversial interpretations of the data, as is done in this thesis.

4.2.1.4 Event-related band amplitude

In many respects, *Event-Related Band Amplitude* (ERBA) is an overarching term covering a method which can combine both ERP and frequency based analyses. Although there have been suggestions of alternative methods (i.e., Vanhatalo et al., 2005), the majority of ERP studies commonly bandpass filter the raw EEG trace in order to analyse the frequencies of most interest, generally from 0.5Hz to 40Hz. Although studies are filtering out much of the gamma activity, they are also filtering out 50Hz mains frequency noise which can plague EEG recordings.

ERBA enables the analysis of how the power of each of the individual frequency bands (i.e., δ, θ, α, β and to a certain extent, γ activity) contribute to the production of the ERP. This is the activity that is produced by generators of a particular band of activity (e.g., alpha), which comes together into phase at the point in which a stimulus is presented, producing a pronounced ERP, and then gradually dissipates and becomes phase-decoupled (Klimesch, Doppelmayr, Röhm, Pöllhuber, & Stadler, 2000). The method of calculating this activity was originally referred to as the *power method* (Kalcher & Pfurtscheller, 1995), but gradually became referred to as the *evoked* activity (i.e., the activity evoked by the stimulus), or the *phase-locked* activity (i.e., the activity locked in phase to the onset of the stimulus). This combined phase-locked activity across all of the frequency bands is essential for what is measured in an ERP and, in the case of ERBA, is expressed as the absolute amplitude of a particular frequency over time (i.e., amplitude $\times$ time).[4]

However, there is also activity present that is not phase-locked to the onset of the stimulus, but is still involved in the processing of the stimulus. Because it is not phase-locked, it is completely subtracted out by the ERP function and is therefore a form of stimulus processing that is often ignored by many ERP studies. This activity can be calculated in a similar way as the phase-locked activity above, using ERBA to calculate it for each of the different frequency bands. It was initially referred to as the *intertrial variance method*, but has since been referred to as the *non-phase-locked* activity (Kalcher & Pfurtscheller, 1995), or the *induced* activity (Klimesch, Russegger, Doppelmayr, & Pachinger, 1998). The calculation of the induced activity can be seen as assessing the evoked activity from the EEG filtered for a specific frequency band (e.g., alpha), and then calculating the squared difference between this filtered, evoked data and the variance of the original mean EEG activity (Klimesch et al., 1998). Essentially, this calculates the remaining activity associated with the processing of the stimulus once the evoked activity is removed and, similar to the evoked activity, is expressed as a function of the absolute amplitude of a particular frequency band plotted over time (i.e., amplitude $\times$ time). This is important because, as Pfurtscheller and Lopes da Silva (1999) have noted, there are several processes that have been identified which are time-locked to the processing of a stimulus, but not phase-locked to it. They go on to explain the functional difference in the cortical physiology as being:

> "...ERPs [i.e., *evoked* activity] represent the responses of cortical neurons due to changes in the activity of local interactions between main neurons due to changes in afferent activity, while ERD/ERS [in

[4]If this was measured in *Event Related Band Power* (ERBP), it would be expressed as the relative power of a particular frequency over time (i.e., power $\times$ time).

this context, *induced* activity] reflect changes in the activity of local interactions between main neurons and interneurons that control the frequency components of the ongoing EEG."

(Pfurtscheller & Lopes da Silva, 1999, p. 1843)

This type of analysis generally focusses on the non-phase-locked information (e.g., Woertz, Pfurtscheller, & Klimesch, 2004), and expresses it in terms of *event-related synchronisation* (ERS) and *event-related desynchronisation* (ERD), with ERS referring to an increase of activity in a particular frequency band after stimulus onset compared to the pre-stimulus period, and ERD referring to a decrease (Kalcher & Pfurtscheller, 1995). It is also usually discussed in terms of Event-Related Band Power (ERBP), and the relationship between ERBP and ERBA is simply as follows:

$$ERBP = ERBA^2 \tag{4.3}$$

It is more useful to convert ERBA to ERBP when calculating ERD/ERS and comparing the post-stimulus period to the pre-stimulus period (Kalcher & Pfurtscheller, 1995). However, when comparing the post-stimulus activity across conditions it is preferable to compare the absolute magnitude offered by the ERBA calculation (Neuroscan, 2003b, p. 173–184), as the peak amplitude across conditions will not be artificially inflated by the squared transform offered by the ERBP analysis.

The use of ERBA analysis is particularly useful for the analysis of the cortical electrophysiology associated with the processing of remote staring detection. This is a similar issue to how EEG and ERPs are generated, and how the measurement of this activity on the scalp is dependent upon the neurons being in alignment and phase. It is possible that there is brain activity being generated in response to a particular stimulus, but because of the lack of neuronal alignment and phase coherence it is not being detected as summated electrical activity by the scalp electrodes. This is an inherent weakness of EEG, but the same core criticism can be levelled at studies which only examine the evoked information over several frequency bands as offered by ERPs. By only examining phase-locked information associated with a particular stimulus, a researcher could be ignoring other processing associated with the stimulus but which is non-phase-locked. Therefore researchers should attempt to examine as much of the data as possible in order to prevent the conclusion that there is no effect when it could lie in the induced activity, and to deconstruct the evoked activity into its composite frequency bands in order to better understand the underlying physiology. This is particularly important when examining phenomena that have never been investigated with EEG before, or when the potential effects are controversial, as with the case of remote staring detection. The exploration of potential effects should be built upon, initially by the use of conventional and established ERP analyses, but then the effect should also be explored for potential non-phase-locked activity as the phase-locked effects could represent only part of the picture.

As can be seen from the quote from Pfurtscheller and Lopes da Silva (1999) above, the evoked and induced components are both complementary and mutually exclusive of one another, and an assessment of both elements is essential for a full understanding of the underlying electrocortical response to a particular stimulus.

4.2.2 Comparing EDA and EEG

As has been discussed in Chapter 3, electrodermal activity has been the principle psychophysiological method for investigating remote staring detection. Although the sections above have explored the potential use of EEG methods to research this phenomenon, it is necessary to compare EDA and EEG methods in order to understand the potential advantages and disadvantages to using both methods for this type of research.

Electrodermal activity measurement has certain similarities to the measurement of EEG, particularly in its use of electrodes that are attached to the body. However, the basic principles are very different. Whereas EEG uses passive detection of electrical activity from the brain, exosomatic methods of measuring EDA are reliant upon passing a very small electrical charge between two electrodes that are attached to the fingers of the participant's non-dominant hand (Dawson et al., 1990). Lykken and Venables (1971) and Fowles et al. (1981) both recommend the use of skin conductance measurement over skin resistance. This is mainly because skin conductance is more linearly related to the number of active sweat glands and the rate of secretion from these glands. This is due to individual sweat glands functioning as linear resistors, and conductance is simply the sum of all the conductors in parellel (Dawson et al., 1990).

The main type of sweat gland that is measured by skin conductance is the *eccrine gland* (as oppose to the *apocrine gland*), which is found on most parts of the body but is the most dense on the palms and the soles of the feet. The eccrine glands have also been found to be more responsive to emotional stimuli, as opposed to thermal stimuli (Dawson et al., 1990). Over the years there have been several theories put forward for explaining the system for modulating skin conductance, but it is currently thought that human sweat glands are primarily controlled by the sympathetic nervous system (Dawson et al., 1990). Obviously, electrodermal activity as a whole is ultimately a reflection of brain processes, and direct electrical stimulation of the cingulate, lateral prefrontal cortex, amygdala, hippocampus and middle temporal gyrus has all been shown to elicit an electrodermal response, emphasising the links between emotion and EDA (Critchley, 2002).

As was explored in the last chapter, EDA has been successfully used for examining remote staring detection, beginning with Braud et al. (1993a). However, its use in parapsychology has been heavily criticised, mainly because of a lack of compliance with standardised practice (Schmidt & Walach, 2000; Schmidt et al., 2001). It is vital that any EEG-based research complies with the equivalent procedural guidelines and standardised practice in order to avoid similar criticisms, particularly as EEG is generally a far more complex method than EDA, resulting in multi-dimensional datasets. The main guidelines are; for research-oriented EEG: Pivik et al. (1993), for clinical EEG: Nuwer et al. (1998), for ERPs: Picton et al. (2000), and for electrode impedance issues: Ferree, Luu, Russell, and Tucker (2001) .

The main reason why EEG methods should be used to investigate remote staring detection is that EDA measures reflect peripheral nervous system activity, whereas EEG and its related methods of analysis allow the investigation of cortical processing of stimuli. Although EDA methods have proved useful in understanding remote staring detection, an evaluation of the possible cortical electrophysiology of this phenomena would have major implications for this area, and for parapsychology as a whole. If processing of "paranormal" phenomena can be demonstrated as occurring in the brain, it would open the gates for an integration between parapsychology and neuroscience and help to provide an answer to the issue of 'materialism' in parapsychology — the criticism that there is no physical evidence that parapsychological phenomena exist and that, as a consequence, explanations for such phenomena are reliant upon mechanisms that currently exist outside of accepted scientific theory.

The use of EEG methods also allows a greater degree of integration between parapsychology and other areas of psychology. The design of many parapsychology experiments is reliant upon controlling for as many extraneous variables as possible, but if the processing of such phenomena occurs in real-life, then it is not restricted by any such controls. This would mean that the processing of more conventional stimuli would occur simultaneously to such processing, and an individual's consciousness would be presented with a package of information about the environment that is independent of the origin of the information — the information from all sources would be integrated. The potential electrocortical processing of remote staring detection might prove to be independent of more conventional processing, or it might be reliant upon it and demonstrated by its impact upon it. The use of EEG methods allows the assessment of this, and because previous research has demonstrated particular forms of processing via EEG methods, then it is possible to gain insight on how remote staring detection works by analysing its impact upon such processes. For example, by examining face processing (see Chapter 5 for a summary of the research on this area), and the impact of remote staring detection upon that processing, it would be possible to understand how the processing of this phenomenon works.

In terms of methodology, EEG is an excellent way of studying remote staring detection. EDA methods were originally easily integrated into the use of CCTV methods in remote staring detection research because both methods required a high degree of control over the laboratory environment. The methodological rigour that is required for EEG methods is even greater than that required for EDA, and is ideal for a lab-based experimental setting. The use of EEG is also a natural extension of Braud et al.'s (1993a) desire to use EDA in order to circumnavigate cognitive interference, as it provides an index of cortical processing without recourse to behavioural measures of cognitive processes. The use of EEG will also assist in a greater understanding of the temporal processing of remote staring detection. One of the unanswered questions of the EDA research is; does the reaction to a remote stare occur instantaneously, or does it slowly build over time as the anecdotal reports suggest? By using a combination of ERP and FFT analyses it is possible to discern if the potential reaction to a remote stare is occurring rapidly, or over the entire duration of the exposure to the stimulus.

Of course, the ideal situation is to use both EDA and EEG methods simultaneously. Although this provides a greater logistical challenge, such a methodology would draw upon the strengths of both methods of psychophysiological measurement, provide a measure of both peripheral and central nervous system activity to remote staring detection, and also allow a direct comparison between the efficacy of the two methods in the measurement of this controversial phenomenon.

4.3 Conclusions

Although EEG and its associated analyses have their limitations, they represent a set of well-established methods and provide a reliable index of the cortical electrophysiology associated with the processing of stimuli. EDA methods have provided a useful initial exploration of remote staring detection, but it is now necessary to build upon this and explore the central nervous system's reactions to this stimulus. However, the optimal approach would be to combine the use of EDA, specifically skin conductance, with both the frequency-based and event-related data provided by the EEG, in order to obtain the most in-depth understanding of this fascinating phenomenon.

Chapter 5

The Power and the Processing of Staring

5.1 The power of staring and gaze

"Gaze" is particularly important within the forms of behaviour encompassed by non-verbal communication (NVC) because it is a *two-way non-verbal channel*. In other words, it can both *send* and *receive* non-verbal information (Argyle & Cook, 1976). Kleinke (1986) has argued that the eyes provide information in several ways, from demonstrating attraction to another, attentiveness, general levels of social competence, mental health, credibility, dominance, and of course, emotions. These properties make it one of the most vital forms of NVC, and also one of the most complex forms to understand, and even the terminology can be difficult to define.

As Argyle (1988) has noted, the term "eye-contact" when discussing dyadic interactions is misleading, as individuals rarely just look at another person's eyes. As Yarbus (cited by Argyle & Cook, 1976) discovered as early as 1967, individuals scan the face in saccadic motion, fixating on particular locations for a maximum of approximately one-third of a second, with the main locations of interest being the eyes and the mouth. This more dynamic type of eye behaviour led Argyle to advocate the use of the term "mutual gaze" (Argyle & Cook, 1976; Argyle, 1988), which can be defined as "...the percentage of time two interactors look at each other in the region of the face." (Argyle, 1988, p. 153).

However, the widespread use of the term mutual gaze, and its interchangeability with other terms, is equally misleading. Argyle and Cook's (1976) text prompted a commentary by Kirkland (1976) on the nomenclature used in the book, which in turn resulted in research by Kirkland and Lewis (1976) and later by myself (I. S. Baker, 2001) examining the suggestion that individuals consistently rate the terms "gaze", "look", "stare", "gawk" and "glance" as referring to different lengths of time of eye-fixation, with *stare* being rated as the longest duration. This creates ambiguity when classifying particular dyadic non-verbal interactions.

This issue is complicated even further when the concept of *staring* is considered. The work by Kirkland and Lewis (1976) and myself (I. S. Baker, 2001) both suggested that a stare was considered to be different from other terms used for eye-fixations. An excellent definition of a stare is as follows; "... a gaze or look which persists regardless of the behaviour of the other person." (Ellsworth et al., 1972, p. 303). This definition is clarified further by the following:

> "The impact of a stare may be mitigated if the starer responds to the other person by smiling or talking; maximal impact will be achieved if the starer simply continues to stare without making any facial or verbal response to changes in the other person's behaviour."
>
> (Ellsworth et al., 1972, p. 303)

Although several types of experiments in the "mutual gaze" literature examine different indices of gaze behaviour in a dyadic interaction, in many social psychology experiments examining the phenomenon the experimental set-up requires one of the individuals in an interaction to look directly at another individual with very little interaction. This is in order to measure the effects of such interaction on measures such as threat and dominance, or on potential changes in arousal (Kleinke, 1986) which will be examined in more detail later. This invariant gaze is usually independent of the behaviour of the other person and is therefore more analogous to the definition of staring behaviour outlined above than "mutual gaze".

The majority of researchers examining "gaze" from cognitive and neuroscientific perspectives are even more guilty of this. The term "gaze" is used throughout the literature, and yet it is a completely misleading term. The majority of these experimental studies are reliant upon measuring the behavioural and physiological reactions to the differences between different types of static images of faces on a screen. However, these images do not respond to any NVC provided by the recipient and are therefore completely independent of their behaviour. The nature of the images and the amount of time that they are displayed for makes them far more analogous to a stare than a more dyadic gaze interaction.

The importance of the eyes in human NVC is underscored by the unique morphology of the human eye itself. Kobayashi and Kohshima (1997) compared the external characteristics of the eyes of nearly half of all of the primate species. They found that the human eye is unique as it has a white sclera which surrounds a darker iris, whereas other primates have a dark sclera and iris. Kobayashi and Kohshima (1997) also found that the human eye has the largest ratio of exposed sclera in the outline of the eye compared to other primates. Kobayashi and Kohshima (1997) suggest that this relationship between the large amount of visible, white sclera to darker iris underscores the importances of looking-behaviour in humans, particularly as the white sclera contrast difference with the dark iris increases the possibility of the detection of gaze or staring direction.

Riccardelli, Baylis, and Driver (2000) tested this suggestion by asking participants to estimate the direction of gaze of black and white images of a woman. Half of images were normal, but the other half had the contrast of the woman's sclera and iris reversed so that these "negative" images had a black sclera and white iris. With the exception of the images that had direct gaze at the participant, Riccardelli et al. (2000) found that participants made significantly more errors when judging the negative images compared to the positive ones, as they found it more difficult and ambiguous to process.

Developmentally, the eyes also appear to have a social significance even to very young children. As early as 1954, Ahrens (cited by Argyle & Cook, 1976) discovered that eyes rather than the mouth tend to elicit a smile response in infants as young as one to two months old. Although the rest of the face becomes more important in following months, the eyes remain the most important stimulus. This finding has been supported by more recent research. Batki, Baron-Cohen, Wheelwright, Connellan, and Ahuluwalia (2000) found that babies spent significantly more time looking at a photograph of a face where the eyes were open compared to the time looking at a photograph of a face where the eyes were closed. Batki et al. (2000) suggested that this is evidence for the importance of eyes and the mechanisms that are in place to orient a baby towards this stimulus. Farroni, Csibra, Simion, and Johnson (2002) found that even very young infants, as young as two to five days old, also look significantly longer at direct gaze images compared to averted gaze images.

Robson (1967) suggested that the importance of the eyes could be the result of natural selection in order to affirm the mother-child bond. This could represent an evolved response in order to promote extended eye-contact between the mother and child and to create a greater bond between the two at a time when children are most reliant upon their mother for their survival. As Argyle and Cook (1976, p. 15) neatly state: "...the mother-infant bond... [is] the first form of social interaction."

However, of all of the research conducted within the social literature on the significance of staring and gaze, the most relevant to the research presented in this thesis is that which examined the effects of staring upon electrodermal arousal, and this material is summarised in the next section.

5.1.1 Electrodermal arousal

During the mid-1960s to late 1970s there were several studies published in the social psychology literature that were examining electrodermal arousal (commonly known at that point as *galvanic skin response*) as a way of understanding the physiological responses to gaze and stares. Due to the prolonged period of eye-contact and the invariant response of the starer's behaviour, these experiments were arguably exploring the impact of staring upon EDA, and in order to understand the effects of remote staring detection on such measures it is necessary to evaluate the impact of more conventional staring detection on EDA.

McBride, King, and James (1965) examined the effects of social proximity on the EDA levels of 20 male and 20 female participants using two male and two female experimenters. They used a within-groups design and placed each participant in several different situations of varying social proximity. McBride et al. (1965) found that there were no significant differences to the EDA responses to a starer at one foot or three foot away, but there was significantly lowered levels of arousal at nine feet away. The response to a male starer at one foot away was significantly higher than a female starer at the same distance for both sexes of staree, which may indicate that males may have a higher likelihood of being perceived as a threat stimulus as suggested by some of the social literature, particularly at this close proximity. Overall EDA arousal was higher towards an opposite sex starer than to a same sex starer, which reinforces the concept of eye-contact being indicative of attraction between opposite-sex dyads.

Similar to McBride et al.'s (1965) research, Nichols and Champness (1971) examined EDA responses to direct and averted gaze using 20 male and 20 female participants and one male and one female confederate. In contrast to McBride et al. (1965), Nichols and Champness (1971) did not find any sex differences, but they did find that the direct gaze of the confederates was overall significantly more arousing to participant's EDA compared to their averted gaze. Nichols and Champness (1971) conclude that this effect is due to "emotional responding" (p. 625), in essence because the prolonged, invariant 'gaze' of the starer at 10 seconds in duration was effectively a stare.

Building upon both McBride et al.'s (1965) and Nichols and Champness's (1971) findings, Strom and Buck (1979) examined the impact of staring in an experimentally-controlled situation. Using an elegant between-groups design, they tested 123 participants for their EDA reactions to a staring or non-staring confederate, using an elaborate cover story for their presence. Strom and Buck (1979) were specifically interested in staring behaviour, being aware of the limitations of the experimental method for limiting naturally dyadic interaction for gaze research, and also being aware of Ellsworth et al.'s (1972) comments on staring. They defined a stare as being, "...a fixed gaze not requiring mutual eye contact and which persists regardless of the behavior of the other person." (Strom & Buck, 1979, p. 114). Participants that were stared at demonstrated significantly higher EDA levels than those that were in the presence of a someone reading a book.

In Strom and Buck's (1979) study, the stared at subjects rated themselves as being significantly more angry, unfriendly, unpleasant and embarrassed. Strom and Buck (1979) were surprised to find that the starers were not rated similarly on these negative scales, and were instead rated somewhat differently as being significantly more tense, angry, embarrassed, passive and less intelligent. Mixed-sex pairs did demonstrate significantly higher EDA levels, although this was independent of whether or not they were being stared at suggesting that the mere presence of another opposite-sex individual is enough to raise EDA levels. Unfortunately, Strom and Buck (1979) added several confounding variables to their experiment. The different ratings given to starers, particularly passiveness and intelligence, emphasise the difficulty in drawing conclusions from research of this type. These ratings could be because the participant identified the confederate as working for the experimenter, or they were rated as being more passive because they were following the experimenter's instructions exactly (i.e., to observe the participant), or as being viewed as less intelligent because in one condition they were reading a book and in another they were not.

Finally, there is research that did not find an EDA reaction to direct versus averted gaze. Leavitt and Donovan (1979) tested 36 women who each had a three month old infant. They were shown 10 second images of a three month infant (not their child) with either direct or averted gaze. The results suggested that direct gaze was no more arousing to EDA than averted gaze. However, these results might be because of the nature of the stimuli. Although child-mother interactions are hypothesed as being of significance and therefore arousing, these infants were not the participants' own children and therefore it could be argued that mothers are selective to responding to the direct gaze of their own infants and will not necessarily then waste their limited resources on other, non-genetically related infants. Alternatively, the mothers might be finding the direct and averted gaze equally arousing and not differentiating between them at all. Both of these potential explanations represent significant limitations of Leavitt and Donovan's (1979) study.

Of course, one main limitation of all of the EDA studies presented above is that all of them were published prior to the publication guidelines for EDA research set out by the *Society for Psychophysiological Research* (Fowles et al., 1981), and therefore have similar methodological criticisms as those levelled at the parapsychological studies that have used EDA (i.e., Schmidt & Walach, 2000).

It is evident from the research presented above that the eyes, gaze and staring have significant social importance and are an integral part of non-verbal communication. However, research from the mid-1980s onwards has focussed primarily upon the cognitive processing of gaze and staring, and the brain activity that might be associated with such processing. This material is the focus of the next section.

5.2 The processing of staring and gaze

As face and gaze processing are both large areas of literature, what follows are details of research that highlights the findings of the areas and the issues involved, with particular emphasis on the use of electrocortical methods and the relevance of the findings to remote staring detection.

5.2.1 The processing of face stimuli

Bentin, Allison, Puce, Perez, and McCarthy (1996) conducted the first study in which ERPs related to face processing were recorded from scalp electrodes. They conducted a series of experiments in which they examined how 12 participants processed different stimuli which were measured from an array of 14 scalp electrodes.

In their first experiment, Bentin et al. (1996) measured a large N170 peak component, which was maximal to face stimuli compared to other stimuli of objects, particularly at the T5 and T6 electrode sites. They also found that this negative component to faces was larger in the right hemisphere (i.e., T6) than the left hemisphere (T5). Bentin et al. (1996) concluded from these results that, as the N170 represents a very early stage of processing at only 170ms after stimulus onset, then face *recognition* is unlikely to be represented by this component. They argue that the N170 might be evidence of activity related to Bruce and Young's (1986) highly-influential face processing model, specifically related to the *structural encoding* phase of the model where the face and its components are recognised as a face stimulus. In their second experiment, Bentin et al. (1996) replicated the results from the first experiment and also found that other body parts (such as hands) did not provide as large a negative deflection for the N170 as faces did. They also found that animal faces did not invoke such a pronounced response, but that the N170 appeared to be related specifically to human faces.

In their third experiment, with a larger 28 electrode montage, Bentin et al. (1996) once again replicated their results for faces, and for the larger response in the right hemisphere (T6), and also found that inverted faces also elicited an N170 that demonstrated a higher negativity than upright faces. Bentin et al. (1996) concluded that this supported the view that the N170 was related to the structural analysis of faces. In their fourth experiment, that is similar to some of the experiments reported in the next section, Bentin et al. (1996) analysed the processing of faces and face components (e.g., eyes, lips, noses, etc) and found further evidence of the N170 being related to the structural analysis of faces. Both faces and eyes elicited larger N170 responses than other facial components, with eyes evoking a greater negativity slightly later in latency than faces. This led Bentin et al. (1996) to conclude that eyes are the single most important component of faces, and that faces and eyes are possibly processed in similar regions of the brain — certainly in different areas than other facial components such as lips and noses. In their final experiment, Bentin et al. (1996) distorted the inner face components in an attempt to examine if the N170 effect was due to eyes specifically or for faces as a whole. They concluded that the N170 effect was associated with the processing of facial features regardless of their location.

Bentin et al.'s (1996) research was an important step in the understanding of the electrophysiology of face processing, and what the N170 component represents. Their research demonstrated that there was a pronounced lateralisation of the effect of faces towards the right hemisphere. Their research also suggested that the N170 is highly suggestive of the process of structurally encoding the face, and that it might also be involved in the detection of eyes, which certainly proved to be one of the single most important structural elements of the face.

Arguably the most important research examining face processing after Bentin et al.'s (1996) work was a series of three papers published in *Cerebral Cortex* that examined responses to face and object processing in 98 patients through the placement of intracranial electrodes directly onto the surface of the cortex (Allison, Puce, Spencer, & McCarthy, 1999; McCarthy, Puce, Belger, & Allison, 1999; Puce, Allison, & McCarthy, 1999). Of these, the first two papers are of most interest here as they were attempting to discern why and in what way face processing is different to the processing of other objects. Allison et al. (1999) initially found a pronounced N200 elicited by faces, which they argue is analogous to the N170 that is measured during scalp recordings, which was dominant in the right temporal cortex (similar to the T6 effect, but more specific due to the superior localisation of the intracranial electrodes). This effect was far larger for faces in this region than for objects, and that this area was particularly sensitive to faces and not other stimuli. Allison et al. (1999) also reported no significant amplitude differences for sex, although males demonstrated a delay in latency for the N200.

Similar to Bentin et al. (1996), McCarthy et al. (1999) found that although there was N170 activity associated with the processing of animal faces, human faces elicited a far greater negativity. They also found that the N200 was larger for faces than face components, and the eyes produced a greater N200 than any other individual face component, suggesting that facial components were still associated with faces as a whole as opposed to the way that other objects are processed. This led them to make an important conclusion about face and eye processing when measured by scalp electrodes:

> "The [face] parts-sensitive ventrolateral sites are primarily located in the inferior temporal gyrus lateral to the occipitotemporal sulcus, at the border between ventral and lateral cortex. The activity generated in this region is probably recordable from scalp locations T5 and T6 and sites inferior to them, and may explain why the scalp-recorded N170 is larger to eyes than to full faces at these locations..."
>
> (McCarthy et al., 1999, p. 442)

McCarthy et al. (1999) also replicated the findings that areas of the right temporal cortex were more involved with the processing of upright faces and then passing the information to the left hemisphere, a finding that was later replicated for both electrophysiological (ERP) and haemodynamic (fMRI) responses by Henson et al. (2003). But McCarthy et al. (1999) also found that areas of the left temporal cortex were optimised to process inverted faces and then passing the information to the right hemisphere. These findings were replicated by Yovel, Levy, Grabowecky, and Paller (2003), who found that faces were processed better when presented in the left visual field (LVF — and therefore processed by the right hemisphere) than the right, but processed optimally when presented to both visual fields as there was a geometrical exchange of information between the two hemisphere for face processing. This was also found by Compton (2002) for the processing and evaluation of emotional facial expressions.

Carmel and Bentin (2002) conducted two experiments which replicated many of the effects noted above. Using 12 participants and a 48 electrode montage, they demonstrated that faces produced a larger N170 in the right posterior temporal region (i.e., T6) than cars or other non-face stimuli in an oddball paradigm where cars were the target. Even though cars, as the target, produced an N170 response that was higher than the other non-face stimuli, this response was not as pronounced as the effect of faces and it was also centralised more at occipital sites (i.e., O1 and O2) than the response to faces. In their second experiment, Carmel and Bentin (2002) found that ape faces, which are structurally similar to human faces, elicited an N170 effect of similar magnitude to human faces, but which peaked 10ms later. Carmel and Bentin (2002) suggested that these results support the claim that the N170 is face specific, and that as the participants were not experts on apes, the similarities in the processing of human and ape faces suggest that the N170 is indicative of a dedicated face processing mechanism in the brain.

Carmel and Bentin's (2002) results formed an important element of an on-going debate concerning whether or not face processing was a product of cortical domain specificity. On one side of the debate there is an argument that face processing is similar to the processing of any other object, but humans are specialised in it because of expertise and practice (Tarr & Gauthier, 2000; Rossion, Curran, & Gauthier, 2002; Tarr & Cheng, 2003). On the other side of the debate, there is the argument that face processing represents a very specific form of domain specificity because of how much more important the recognition of faces and the components that comprise them are compared to that of other, less socially significant objects (Kanwisher, 2000; Carmel & Bentin, 2002; Bentin & Carmel, 2002).

In an attempt to answer this debate, Itier and Taylor (2004) conducted an extensive study where they compared the processing of the N170 and the *Vertex Positive Peak* (VPP), both of which have been associated with face processing, and how they are elicited for the processing of different stimuli. Only the data for the processing of the N170 component will be highlighted here, as more recent research has found evidence that the N170 and VPP are actually two aspects of the same neural generator, and the differences in their effect presented in the literature are a classic example of artefact generation caused by reference electrode site placement (Joyce & Rossion, 2005). Itier and Taylor (2004) tested 16 participants with a 35 electrode montage for their processing of faces, inverted faces and seven different object categories. They found that faces produced a significantly shorter latency and greater N170 amplitude compared to all other stimuli, with inverted faces resulting in a greater amplitude than normal, upright faces. Itier and Taylor (2004) also found maximal global field power (GFP) for faces at N170, and the voltage maps for this time frame revealed that faces were processed in the T5 and T6 regions, whereas objects were processed more occipitally. They suggest that the differences between face and object processing, particularly the differences in GFP, might reflect the recruitment of extra neural generators for the processing of faces, lending support to the argument that the processing of faces is domain specific.

The question regarding the domain specific processing is a controversial one, as in many respects it ties directly into the nature/nurture debate. However, regardless of the potentially specialised nature of face processing, it is evident that faces are processed significantly differently from objects. This difference in processing results in significantly larger amplitude deflections to faces at the T5 and T6 sites, with greater activity in the right temporal cortex.

This pronounced difference in the processing of faces and other objects is a significant advantage for furthering the understanding of how remote staring detection might be processed. It is possible that the brain employs similar mechanisms to the processing of information associated with someone looking at you, regardless of the exact nature of that source. Therefore, if the mechanisms dedicated to face processing are also employed for the analysis of remote staring detection then by introducing both stimuli to the individual at the same time it is possible to examine the effects on face processing with a remote stare as opposed to face processing on its own. It is unclear what this exact nature of this effect may be. The input of two stimuli that have to be processed by the same mechanism may result in an impairment or slowing of processing speed, or an enhancement as greater activity is expected from that particular system. By also using object stimuli and comparing the results of object processing and object processing plus a remote stare, it is possible to determine if the potential impact of remote staring processing on other processes is specific to the face processing systems, or if it is not as specialised but can have an impact upon a variety of other concurrent processes.

5.2.2 The processing of eye stimuli

> "Imagine you walk into a crowded train. You see a remaining empty seat, so you go across and sit down. You get out your book, and settle into it. During the journey, you become aware of a feeling that someone is looking at you. You glance along the carriage and, sure enough, someone is looking at you. As soon as you make eye contact with this stranger, he looks away. To my mind, this phenomenon is rather striking, in that *it is not immediately obvious how you would have known that someone was looking at you*, if you were engaged in another activity."
>
> (Baron-Cohen, 1995, p. 97, emphasis added)

The above quote from Baron-Cohen (1995) neatly encapsulates much of the research conducted from the early 1990s onwards that has attempted to understand why and how people process the gaze[1] of others. Baron-Cohen (1994, 1995) was attempting to evaluate how the understanding the gaze of others contributes to an individual's *theory of mind*, which in this context refers to the ability to understand what another person is looking at and what their motivations are for looking at it. This is also important to understanding how a person detects someone looking at them, and how they understand that individual's intentions toward them.

Baron-Cohen's (1995) "mindreading" model comprises of four main components; the *Intentionality Detector* (ID), the *Eye-Direction Detector* (EDD), the *Shared Attention Mechanism* (SAM) and the *Theory of Mind Mechanism* (ToMM) (see figure 5.1). A summary of the model is as follows; the ID is a perceptual device that detects, on a primitive level, motion stimuli in terms of the desires and goals of the agent which generated the motion. The EDD

[1] As was noted in section 5.1, there are fundamental issues surrounding the use of the term "gaze" in research of this type, as so much of it effectively measures reactions to staring behaviour. However, as the vast majority of the research in cognition and neuroscience employs this term, for the sake of consistency the term gaze will be used.

has three basic functions; it detects the presence of eyes or eye-like stimuli, it determines where the eyes are looking (generally by examining the position of the iris in relation to the contrast differential of the sclera, see Kobayashi & Kohshima, 1997), and it finally infers the action of 'seeing' to an agent whose eyes are directed towards a person or object, as opposed to merely looking without intent in a particular direction. Baron-Cohen (1995) suggests that the ID and EDD can operate simultaneously and independently of each other, the processes of both feeding into the next component, the SAM. The SAM builds triadic representations (between an agent, the self and a third object), which enable a person to understand that another person is attending to the same thing, and essentially that both are thinking about the same thing, be it a goal or object. This information feeds into the final component, the ToMM, which finishes the process using its two main functions. The first, Baron-Cohen argues, is the ability of the ToMM to infer that a person can have a particular mental state based on their observed behaviour, and secondly it enables the person to create a theory to explain and predict another's behaviour. Baron-Cohen's (1994, 1995) theory is complex and has been used to try and explain a variety of behaviours and disorders, particularly autism. However, the main component of interest to the research proposed here is Baron-Cohen's (1995) idea of an eye-direction detector (EDD), as it has helped to demonstrate the vital importance of gaze detection and processing in human interactions. Baron-Cohen's (1995) model and the EDD in particular, have had an important impact on the cognitive and neuropsychological research into gaze, mainly because he proposes that there is a "...specialised part of the human visual system..." which actively "...detects the presence of eyes or eye-like stimuli..." (Baron-Cohen, 1995, p. 38).

At the same time as Baron-Cohen's (1994, 1995) research, a convergent line from neuroscience was proposing that an area in the temporal lobe of the cortex called the *superior temporal sulcus* (STS) might be responsive to faces in general and to gaze in particular (Perrett et al., 1992; Perrett & Emery, 1994; Langton, Watt, & Bruce, 2000). Campbell (1990) and Heywood and Cowey (1992) found that lesions in the temporal lobe of monkeys, particularly in the STS region, resulted in an impairment of judgement of gaze direction. This phenomenon had also been noted in prosopagnosic patients (patients who have impairments at being able to recognise familiar faces) who can have abnormalities in the STS region (Perrett et al., 1988). Perrett et al. (1992) conducted single-cell studies in the STS region of the macaque temporal lobe, and found that there are groupings of cells in this area which are very sensitive to the gaze of others, and that there

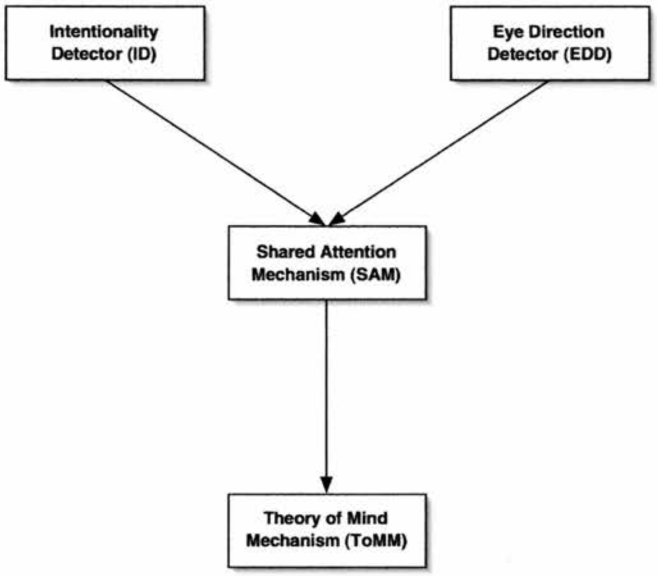

Figure 5.1: "The Mindreading System" (Baron-Cohen, 1995, p. 32)

are areas within it which can discriminate between direct and averted gaze (see also Perrett & Emery, 1994). Unfortunately, Perrett et al.'s research suffers from the fact that it was conducted on macaques and it involved single-cell studies, both of which limit the generalisability of the link between the EDD and STS in humans.

However, the importance of the processing of the looks of others and its potential links with proposed cognitive and cortical processes galvanised research into gaze processing and its relationship with face processing. Taylor, Itier, Allison, and Edmonds (2001) conducted two studies with 27 participants where, in the first study they compared the processing of full faces, eye movement and other stimuli, and in the second study they examined eyes-only processing, eye movement and other stimuli. Using a 29-channel EEG system measuring event-related potentials (ERPs), they found that during the face task females processed faces quicker than males (N170 component), and that faces were processed quicker and revealed a higher amplitude response compared to the other stimuli. The eyes-closed condition for the faces did not reveal any amplitude differences, but there where slightly longer latencies compared to eyes-open which may reflect a longer search-time required for scanning an stimulus (i.e., a face) in which eyes are expected to appear.

Taylor, Itier, et al.'s (2001) results for the eyes-only study were confounded to some extent by the additional presence of lips below the eye-stimuli. The second study duplicated the results of the first study in that eyes-open were processed quicker than eyes-closed, although they also found slightly smaller amplitudes for eyes-closed. They reported no significant differences in processing between direct and averted gaze. Taylor, Itier, et al. (2001) concluded that the direction of gaze has a very subtle effect on the early stages of face processing. They also suggested that processing differences between direct and averted gaze, which they did not find, might be reflected in processing of the movement of the eyes and therefore not reflected in the presentation of these static images. The potential role of the STS region in this processing of the direction of social attention as indicated by eye movement, reflected by Baron-Cohen's (1995) "shared attention mechanism", has been neatly summarised by both Langton et al. (2000) and Allison, Puce, and McCarthy (2000). In comparing the data from the two studies, Taylor, Itier, et al. (2001) concluded that the N170 component was particularly sensitive to the manipulation of face stimuli, a similar conclusion to their findings for the magnetoencephalographic[2] (MEG) study that they conducted into the same phenomenon (Taylor, George, & Ducorps, 2001). They also concluded that eyes-only had longer processing latencies of the N170 component than full faces, which could reflect that an issue of ecological validity in that individuals are more used to processing eye-stimuli within the context of the faces as a whole, and therefore it may take slightly longer to process eyes that are taken out of their contextual setting. Interestingly, Taylor, Itier, et al. (2001) also suggest that the use of electrocortical methods for attempting to study gaze processing is problematic, concluding that:

> "This region [the STS] of the human brain is not accessible in intracranial surface recordings nor would lateral scalp recordings be sensitive to activity in this region, which is within a sulcus and would produce a vertical dipole."
>
> (Taylor, Itier, et al., 2001, p. 339)

However, Watanabe et al. (2002) would strongly disagree with this conclusion. They tested 14 participants for the ERPs for processing direct and averted gaze images (within full faces). They only measured from three electrode locations, Cz, T5' and T6' (these final two sites are non-standard

[2]Magnetoencephalography is a method for examining brain activity that shares many similarities with EEG. However, whereas EEG measures *electrical* activity from the cortex, MEG measures the *magnetic* field that these electrical currents produce (as per the right-hand rule). The advantage of this method is that the spatial resolution is superior to EEG, however the equipment is enormously expensive to purchase and to run.

locations, 2cm below the T5 and T6 electrode sites). They argue that these locations are directly over the STS region based upon previous research measuring face-specific ERPs (e.g., McCarthy et al., 1999; Allison et al., 1999). However, the previous research was reporting findings from intercranial electrodes, and the waveform propagation due to volume conduction from this activity would be easily detectable from more conventional 10–20 electrode sites such as T5 and T6, or indeed other areas in the temporal lobes. The spatial resolution of ERPs is low enough to make such specific attempts at electrode placement redundant, particularly as the STS resides in a sulcus in the cortex which makes source localisation more problematic as it is a deeper brain structure than a gyrus. However, during their analysis Watanabe et al. (2002) found processing for both types of gaze was larger in the right temporal cortex than the left, and that the peak amplitude for the averted gaze was significantly higher than the direct gaze condition, with no shifts in latency, which is similar to the non-significant findings of McCarthy et al. (1999). In contrast, Taylor, Itier, et al.'s (2001) study above failed to find any significant differences between the processing of direct and averted gaze. Interestingly, Puce, Smith, and Allison (2000) found similar results to Watanabe et al. (2002) but using a different method that was focussing upon the processing of *eye-movement* and not *eye direction*.

Watanabe et al. (2002) appear to have difficulty in attempting to reconcile these previous research findings with their own results. What may have happened is that Watanabe et al. (2002) had an inter-stimulus interval (ISI) of between 1000–1600ms, but Taylor, Itier, et al. (2001) had an ISI of between 1800–2200ms. Instead of the participants seeing two discreetly different stimuli (i.e., direct and averted gaze), the shorter ISI of Watanabe et al. (2002) may have contributed to their perception that the eyes were actually moving as the conditions flicked rapidly back and forth, and the activity that they measure is actually due to the STS being sensitive to socially relevant visual movement, as suggested by Allison et al. (2000), rather than the processing of eyes in a particular alignment. Taylor, Itier, et al. (2001) did not find this significant difference between the two conditions possibly because their ISI was large enough for the participants to be able to perceive two discreet stimuli that did not give the illusion of movement.

Farroni et al. (2002) conducted an experiment that found similar results to Watanabe et al. (2002), except that the sample was far younger. They tested 15, four-month old infants for the processing associated with direct and averted gaze (within full faces) using a 62 electrode set-up measuring ERPs. They found that the N170 peak for face processing measured in adults actually peaked at 240ms in children (which they refer to as the 'infant N170'), and although this is a somewhat specialised sample, these findings emphasise the methodological point that differences in sample populations from experiment to experiment can result in the movement of the timing of ERP components considerably. Farroni et al. (2002) also found that averted gaze produced significantly larger peak processing compared to direct gaze (i.e., more negative shift). These results suggest that even very young infants process eye position and they provide further evidence for the importance of faces and eyes in social perception. However, as the stimuli were presented within the context of a face they also state that the result, "...does not provide support for arguments involving an innate neural module for eye-gaze detection that is dissociable from general face processing." (Farroni et al., 2002, p. 9604).

Farroni et al.'s (2002) conclusions are far more balanced than Watanabe et al.'s (2002) as they are willing to acknowledge that this is a complex issue that has not yet been resolved. Although the eyes are evidently an important element of the face, it has not yet been firmly established exactly how or if they are processed independently of the rest of the face, mainly because they are usually seen within the context of the face as a whole. The results of the studies examining eye-gaze processing are somewhat ambiguous as they need to combine the eye stimuli with the processing of other elements of the face, particularly as it is often a combination of different facial structures that allow an individual to build a 'theory of mind' concerning another person's intent or emotional state, or whether or not they recognise them.

5.2.2.1 Eye stimuli and remote staring detection

Within the context of remote staring detection, the comparison with gaze processing may initially appear to be valid. If remote staring detection is related to other, more conventional processes, then the processing of gaze in general may be one of the primary possibilities. However, there are several problems with specifically comparing eye gaze to remote staring detection. Firstly, several studies that have examined eye gaze processing have examined it within the wider context of face processing in general (as the studies above have demonstrated), placing the eye-stimuli within face stimuli. Secondly, the results from such studies are ambiguous and it is unclear if eye stimuli are processed separately to face processing in general. Additionally, it is unclear if the differences noted between the processing of direct versus avert gaze are due to differences in the stimuli (i.e., the contrast ratio differences of exposed white sclera of each side of the iris), or because it is evidence of EDD or SAM functioning as part of Baron-Cohen's (1995) model. The differences could also be due to the perception of socially relevant eye-movement directing attention, but not necessarily due to the processing of direct and averted as different stimuli *per se*.

The most important issue surrounding the use of eye-only stimuli for comparing conventional processing of gaze to remote staring detection is the use of averted gaze. The main comparison that gaze studies make is to compare direct with averted gaze in order to attempt to manipulate only differences in the eyes and allow all other face components to be constant. However, there is a fundamental issue surrounding the ecological validity of comparing averted gaze and the potential processing of remote staring detection. In a 2×2 design, two conditions would be the conventional processing of direct gaze and averted gaze. The second two conditions would be examining the potential impact on processing with the addition of remote staring to the processing of direct and averted gaze. This may work well for comparing the impact of remote staring detection to direct gaze, as the individual would be processing a image of someone looking at them on a screen, and also processing someone looking at the remotely via a CCTV link. However, attempting to compare how an individual processes the image of someone with averted eyes, and at the same time attempting to processing someone looking at them remotely does not make sense as the two types of stimuli are incompatible (i.e., normal *averted* with remote *direct*) and the conclusions that can be drawn from such processing would be problematic at best.

However, more general face processing as opposed to specific gaze processing may offer a better stimulus type for examining the impact of remote staring detection upon more conventional processing. Not only do faces also contain eye-stimuli, they also convey more information about the mental intent of the individual who is looking. Additionally, they offer a more ecologically valid stimulus as people are used to looking at faces in their entirety, and also the findings concerning the electrocortical activity involved in face processing are less ambiguous. From a practical and conceptual perspective faces are also a more valid stimulus for examining the impact of remote staring detection as they are often compared to other, considerably different stimuli such as objects, in order to examine if the processing of faces is somehow special.

5.3 Conclusions

Being able to tell when and why someone else is looking or staring at us is evidently highly significant from a variety of perspectives. It is a vital part of understanding non-verbal communication, and it can have an impact upon our cortical processing and our autonomic nervous system activity.

Baron-Cohen's (1995) model has been highly influential in explaining the importance of the stares of others and for the mechanisms behind their detection. His impetus to explain this ability is neatly demonstrated when he is discussing this amazing ability to detect when we are being stared at, even when "... it is not immediately obvious how you would have known that someone was looking at you." (Baron-Cohen, 1995, p. 97). But this quotation can also be used to demonstrate the need to explain remote staring detection, as it emphasises how the mechanisms suggested by Baron-Cohen (1995) can also be extended to help understand the wider ability to detect when someone is looking at you.

Although it is extrapolating Baron-Cohen's (1995) model beyond its original intention, the concept of the EDD and its ability to detect when we are being looked at, and the related activity in the STS region, can easily encapsulate remote staring detection. As the following quotation suggests, in many respects remote staring detection could represent a natural extension to, or an anomaly of, the more conventional detection of when we are being watched:

> "It makes good evolutionary sense that we should be *hyper-sensitive* to when another organism is watching us, since this is about the best '*early warning system*' that another organism may be about to attack us, or may be interested in us for some other reason."
>
> (Baron-Cohen, 1995, p. 98, emphasis added)

In order to evaluate the potential relationship between the electrophysiological detection and processing of more conventional staring behaviour and remote staring detection, it is essential to measure the processing of both phenomena separately, and then the effect of simultaneous processing. Furthermore, as it unclear how eyes might be processed differently or independently of their context within faces (if at all), it is important that the stimulus for evaluating conventional staring behaviour incorporates the entire face. The use of an entire face as a stimulus also provides an opportunity of evaluating whether or not remote staring detection is related specifically to face processing, or can be examined within the context of the processing of a variety of different stimuli.

Chapter 6

Exploring Remote Staring Detection and the Brain

6.1 Introduction

The first experiment to ever examine the potential cortical electrophysiology associated with remote staring detection had two primary objectives; (a) to study the possible processing related to remote staring detection on its own, and (b) to examine if there was a potential relationship between remote staring detection processing and the processing surrounding staring in general.

In order to study the first objective it was necessary to compare the processing in the staree's brain associated with being stared at remotely by the starer, with a baseline form of processing without a remote stare. In order to make this design comparable with previous remote staring detection studies and to minimise the noise associated with processing other stimuli, the staree had to look at a blank screen (i.e., minimal visual stimulation) in both conditions. As there should be only random processing associated with watching a blank screen (as it is not time-locked to the presentation of a particular stimulus), by comparing this with the processing associated with a blank screen plus a remote stare, any significant differences should theoretically be evidence of the processing associated with remote staring detection.

Similar to previous remote staring detection studies, the stimuli were repeatedly administered for the purposes of signal averaging. For example, Braud et al. (1993a) used 10 stare and 10 no-stare periods, each lasting 30 seconds each. However, due to the use of event-related EEG measures (such as ERPs) this experiment used a greater number of repetitions of the stimuli for signal averaging than previous studies, as ERPs require far more repetitions in order to provide an adequate signal-to-noise ratio. Another consideration was that because participants can only endure a finite period during testing, the duration of each stimulus period in the experiment was shorter than previous experiments using EDA measures.

A particular strength of this method was that by examining the processing associated with the stimuli via event-related measures such as ERPs, and the processing associated with comparatively longer periods (e.g., using FFTs), it allowed the data to be examined in different ways. A result of this was that the data can be used to explore the issue of *detection onset*. One of the questions surrounding remote staring detection is how quickly the detection occurs. As many previous experiments have used a relatively long duration for the stare and no-stare periods and examined the EDA data for the entire period, there has been no resolution to the question of whether the differences in the physiological response occur relatively quickly, as some anecdotal reports may suggest, or slowly build over a longer period of time. By employing different analysis methods, evidence exploring this issue was gathered.

As Braud et al. (1993a) noted, the use of EDA methods is particularly appropriate for lab-based parapsychological research as the types of controls required for good-quality recordings are complementary to the types of controls which are required for parapsychology experiments. This is even more appropriate for EEG methods, as they require even more controls than EDA methods. In order to examine remote staring detection using EEG, experimental procedures were introduced that were conducive to both methods. For example, the experiment incorporated a randomised, counter-balanced design. The experimenter and the participant were also both blind to the order of stimulus presentation (i.e., a *double-blind* design).[1] Also, the system — including the CCTV camera, EEG acquisition and control of all stimulus presentation — was fully automated and computer controlled. Most importantly, the starer and staree were separated into different rooms as far apart as logistically possible in order to eliminate any sensory leakage between them. Finally, it was important as a procedural element to foster a rapport between the experimenter/starer and the staree. This was not only important in light of findings from the remote staring detection literature (i.e., Watt et al., 2002), but also because the amount of technical equipment required for EEG measurement can be particularly intimidating for the participants and it is vital that they are as comfortable as

[1] As the experimenter also acted as the starer, which is common in remote staring detection studies, it could be suggested that this is effectively a *triple-blind* design.

possible during the experiment and do not feel dehumanised.

It was also desirable to make the findings of this initial exploration of the potential electrocortical processing associated with remote staring detection comparable with previous studies that have employed EDA measures. In order to do this, skin conductance was also measured at the same time as the EEG to make such comparisons possible. In addition to this, and in light of previous research examining the potential personality correlates of remote staring detection (see section 3.4 on page 40), participants were also asked to complete questionnaires examining self-consciousness (Fenigstein et al., 1975) and paranoia (Fenigstein & Vanable, 1992) before the experiment.

In order to examine the potential relationship between the processing that may be associated with remote staring detection and the processing of stares, two more conditions were added to the two conditions outlined above. As was noted in the last chapter, full faces provide a more optimal stimulus than just eyes to examine the effects of the processing of stares as they are more ecologically valid (i.e., eyes are usually seen within the context of a face, indeed many of the gaze experiments use full face stimuli). Also, the results of the processing of just eye-stimuli are ambiguous, and face processing can be readily compared to other forms of processing. The first additional condition involved presenting the staree with a picture of a face on its own in order to provide a 'baseline' of processing that is associated with faces. In addition to this condition, the staree was presented with the image of the same face used above, but at the same time they were also stared at remotely by the starer via the CCTV camera. By comparing the processing associated with a face on its own with a face plus a remote stare, it was possible to discern any potential effects of remote staring detection on the processing of more conventional staring or faces. As this could manifest as latency shifts or alterations in the peak amplitude of processing between conditions, the use of Global Field Power (GFP) provided an excellent means of obtaining an global perspective on any differences in processing. By using GFP as a main measure, it was then possible to explore any potentially localised effects using *post-hoc* analyses. As an important methodological point, the face stimulus used for both the face only and face plus remote stare conditions not only needed to be the exact same stimulus, but it also needed to be an image of the face of the starer. This was to provide *ecological consistency*, as it is unclear the potential affects of being stared at remotely by one person and being stared at directly (by viewing their face) by another person at the same time.

This resulted in a 2×2 design where participants (i.e., the staree) were exposed to repeated stimulus administrations of either a face or a blank screen, and either with or without a remote stare, during which their skin conductance as measured and their brain activity was being monitored by a 40-channel EEG machine. Prior to this, participants were asked to complete a self-consciousness questionnaire and a paranoia questionnaire, in order to see how these factors might correlate with remote staring detection.

As this experiment represented a new methodological design to previous experiments in the literature, a considerable amount of practical (and theoretical) 'groundwork' was required. Because of this, the system was thoroughly tested followed by a pilot study of the main experiment. As the pilot study resulted in some changes to the method, it is outlined below after the method section. The system test is outlined before the main results.

6.2 Method

6.2.1 Participants

21 participants[2] took part in this experiment (seven males and 14 females), and their average age was 26.0 years old (ranging from 21 to 41 years old). The participants were selected using opportunity sampling and were not paid to take part. The majority of participants were right-handed (two were left-handed). The experimental design received ethical approval from the Ethics Committee of the School of Philosophy, Psychology and Language Sciences at The University of Edinburgh.

6.2.2 Materials & Equipment

6.2.2.1 Electroencephalogram measure & experimental computer

The experimental computer had a AMD-K7, 650Mhz processor with 384Mb RAM, with a medical-grade isolated power source, and was running Windows Me. It was connected to an experimenter's monitor (15" Ilyama Vision Master 350), a staree's monitor (17" Elonex MN044), and a starer's monitor (17" Ilyama Vision Master Pro 410) via standard 15-pin monitor cables. Connected to the experimental computer was a video-camera (Logitec Quick-Cam Messenger), and a SC preamplifier, which in turn was connected to a SC analogue-to-digital

[2]The data from 20 participants is included in the analysis. The data from one participant had to be removed due to technical problems with the data collection. An additional participant was recruited to replace this data as 20 participants were pre-specified before the experiment.

converter (both amplifier and converter were part of the same system; Contact Precision Instruments SC5-SA 24bit Skin Conductance Unit). The skin conductance electrodes were sintered silver-silver chloride Ag-AgCl. The gel used with the skin conductance electrodes was a custom-made pH balanced aqueous gel.

The EEG computer was a DELL Inspiron 8100 laptop, with a Pentium III 1.0Ghz processor and 128Mb RAM. It had an isolated medical-grade power supply, and was connected via USB cable to the NeuroScan NuAmps 40-Channel Digital Amplifier. This optically-isolated amplifier was connected to the experimental computer via a 25-pin cable. The electrode caps used were NeuroScan Quik-Caps, 40-channel electrode caps designed for the NuAmps system.[3] The Quik-Cap, ocular and ear electrodes were all sintered silver-silver chloride Ag-AgCl. The gel used with the EEG electrodes was Neuromedical Supplies QuickGel, designed for use with the NuAmps system. The software used to record the EEG data was the Acquire package of NeuroScan's Scan 4.3 EEG processing suite.

The experimental computer was responsible for running the experimental program, displaying the relevant information to the experimental, starer and staree computer screens, and sending the event triggers to the EEG computer. The EEG computer was purely responsible for recording the EEG. The EEG and experimental computers were connected in the schematic displayed in figure 6.1.

The program[4] (written in Microsoft Visual Basic V.6) controlling the entire experiment administered the following four conditions:

- *Face perception condition* — In this condition the participant would see a picture of the experimenter staring directly at them. During this time the starer (who is also the experimenter) would be looking at a black screen.[5]
- *Remote staring condition* — In this condition the participant would see a black screen, and the experimenter would see a live video feed of the participant.
- *Face + remote staring condition* — In this condition the participant

[3]The recording electrodes were as follows: Fp1, Fp2, FT9, FT10, F7, F8, F3, F4, Fz, FT7, FT8, FC3, FC4, FCz, T7, T8, C3, C4, Cz, TP7, TP8, CP3, CP4, CPz, P7, P8, P3, P4, Pz, P1, P2, O1, O2, Oz, A1, A2, VEOG+, VEOG-, HEOGL, HEOGR and the non-recorded GND. These were positioned in a standard 10–20 arrangement.

[4]I would like to thank Dr Paul Stevens for writing all of the experimental programs used in the different experiments reported in this thesis.

[5]The use of the experimenter as a starer is common in the remote staring literature (e.g., Braud et al., 1993a; Wiseman & Schlitz, 1997).

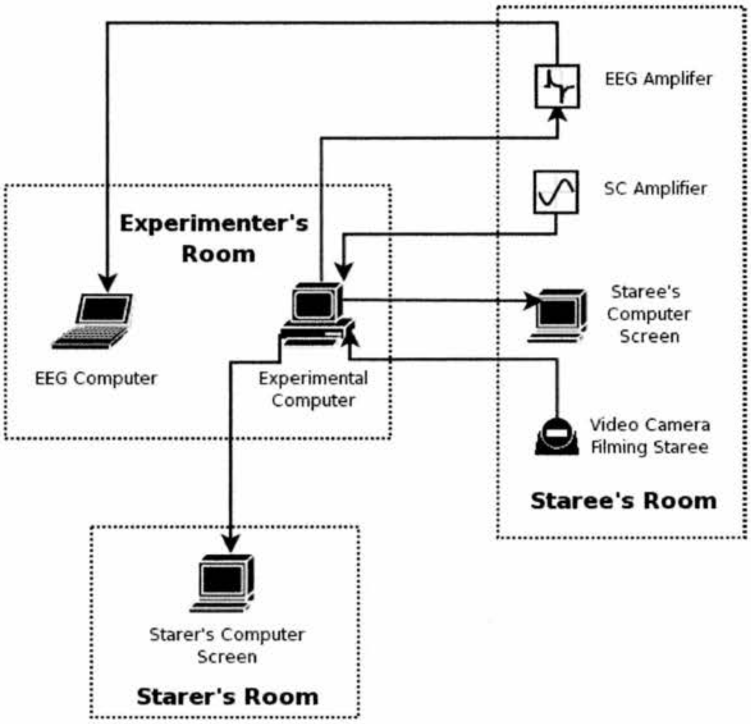

Figure 6.1: Diagram of the set-up of the experimental equipment

would see a picture of the experimenter staring directly at them, and the experimenter would see a live video feed of the participant.

- *Control condition* — In this condition both the participant and the experimenter would see a black screen.

The relationship between these conditions is more clearly evident in table 6.1.

	Face Displayed	Blank Screen
Remote Stare	*Face + Remote Staring Condition*	*Remote Staring Condition*
No Remote Stare	*Face perception Condition*	*Control Condition*

Table 6.1: 2 × 2 table of the independent manipulation

To prevent the participant from perceiving any indication that the camera was on or off at any one time, the camera was effectively on all of the time. The computer program was designed to place a black "mask" over the feed from the camera to the starer, so that the feed was continually active, but the starer was only exposed to it at the appropriate moments as deemed by the randomisation schedule.

The sample-rate of the EEG recording was 500Hz, with a bandpass filter at 0.5Hz (High Pass), and 100Hz (Low Pass), with a 50Hz notch filter. Each condition lasted for 5000ms which was then followed by a 5000ms rest period, in order to prevent any contamination of the EEG results from one condition to the next. At the beginning of the presentation of each condition and rest period, a TTL pulse was sent by the experimental computer to the EEG machine in order for the EEG trace to be time-stamped with the condition identifier. Each condition was presented 48 times, in a pseudo-randomised[6] and counterbalanced order which was automatically changed by the computer for each participant. When the program was enabled, the experimental computer was locked-out until the end of the session or the program was aborted.

The session details were automatically recorded by the experimental computer at the end of the session with the skin conductance recording as a text file. The EEG recording was saved as a continuous file on the EEG machine. Back-ups of all of the data were saved to DVD-ROM.

6.2.2.2 Skin conductance measure

The skin conductance (SC) electrodes (sintered silver-silver chloride Ag-AgCl) were applied to the medial phalanges of digits II and III of the non-dominant hand (as per the guidelines set out by Fowles et al., 1981) using custom-made pH balanced aqueous gel and adhesive collars. The SC electrodes were then connected to the SC amplifier and the participant was asked to perform a number of short breathing exercises in order to verify the electrode connection. The SC electrodes were then temporarily disconnected until the experiment was ready to start. The positioning of the electrodes at this stage allowed the participant's skin to have the maximum amount of time to acclimatise to them.

The skin conductance of participants was recorded automatically by the experimental computer during the session. The sample rate was 40Hz, and the data was time-stamped for the individual sessions. The SC data was epoch-stamped in a similar way to the EEG data, with a record being placed on the data detailing the stimulus type of each individual epoch. The final recording for each person contained the raw SC data, the condition markers, the time stamp for the start and the end of the session, and a data stamp.

[6]The randomisation sequence was generated via a seed from the computer clock at program start.

6.2.2.3 Questionnaires & stimuli

Three questionnaires were used in this experiment, a general demographics questionnaire, the 23-item Self-Consciousness Questionnaire (SCS) (Fenigstein et al., 1975; Burnkrant & Page, 1984; Mittal & Balasubramanian, 1987) and a 20-item *non-clinical* paranoia questionnaire (Fenigstein & Vanable, 1992). The SCS is designed to measure three factors; *private self-consciousness* (10 questions), the awareness and concern with the self; *public self-consciousness* (seven questions), an awareness of the reactions of others to the self; and *social anxiety* (six questions), anxiety over the awareness of self as and the evaluation of others. Further research on the SCS by Burnkrant and Page (1984) has suggested that five items from the original SCS be dropped, and that the dimension of private self-consciousness should be divided into two separate dimensions; *self-reflectiveness* and *internal state awareness.* However, Burnkrant and Page's (1984) research has been criticised. Mittal and Balasubramanian (1987) argued that, although the private self-consciousness dimension can be split, the public self-consciousness dimension can be split too, into *style consciousness* and *appearance consciousness.* Mittal and Balasubramanian (1987) also argued that the items that Burnkrant and Page (1984) dropped were incorrect, and a different set of items should be dropped.

In light of this debate, the full 23-item SCS was used in this experiment, and the analysis adopted the dimensionality and exclusion of items that Mittal and Balasubramanian (1987) advocate in their analysis.

The non-clinical paranoia questionnaire is designed to measure a single factor of paranoia (as demonstrated by the analyses of this questionnaire shown in Fenigstein & Vanable, 1992). Obviously, there is a certain degree of overlap between the concepts that these two questionnaires are designed to measure. As measured by Fenigstein and Vanable (1992) (using the measures from the original Fenigstein et al. (1975) analysis) the correlations between the SCS and the paranoia scale were: $r_{(581)} = .40$, $p = .01$.

6.2.3 Hypotheses

Although this experiment was primarily exploratory, a number of hypotheses were proposed *a priori* based on research from the face perception and DMILS literature:

1. There will be a significant difference in the mean skin conductance activity between the remote staring condition and the control condition.

2. There will be a significant difference in global field power (GFP) peak amplitude between the face perception condition and the face and remote stare condition.

3. There will be a significant difference in global field power (GFP) peak amplitude between the remote staring condition and the blank screen (control) condition.

4. There will be a significant correlation between remote staring detection and questionnaire (paranoia and SCS) scales.

5. There will be a significant positive correlation between the paranoia and SCS scales.

6.2.4 Procedure

The procedure of the experiment broadly followed the DMILS experimental procedure outlined by Braud and Schlitz (1991) and the more specific remote staring research procedure outlined by Braud et al. (1993a, 1993b). Additional elements were also added due to the increased technical complexity of this experiment and due to the logistical issues raised from the use of the EEG measure.

The participants were greeted at the entrance of the Department of Psychology and escorted up to the Koestler Parapsychology Unit research laboratory on the second floor. They were encouraged to make themselves comfortable and offered non-caffeine based refreshments. The experimenter then took them on a short tour of the facility, in order to familiarise them with the equipment, the nature of the experiment and to help them understand where the starer would be in relation to them. The layout of the testing facility can be seen in figure 6.2. Due to the technologically-oriented nature of this experiment, it was vital that the participants not only felt as comfortable as possible with the set-up, but also that they understood the nature of the experiment so they could make fully informed consent. The procedure was also attempting to maximise the rapport between the experimenter and the participant.

The individual pieces of experimental equipment were described in detail, particularly the nature of the electrodes and how they would be placed upon the participant. The procedure of the experiment was also described. The participant was informed that the nature of the experiment was to see how people react to being stared at. As part of this, they would be exposed to pictures

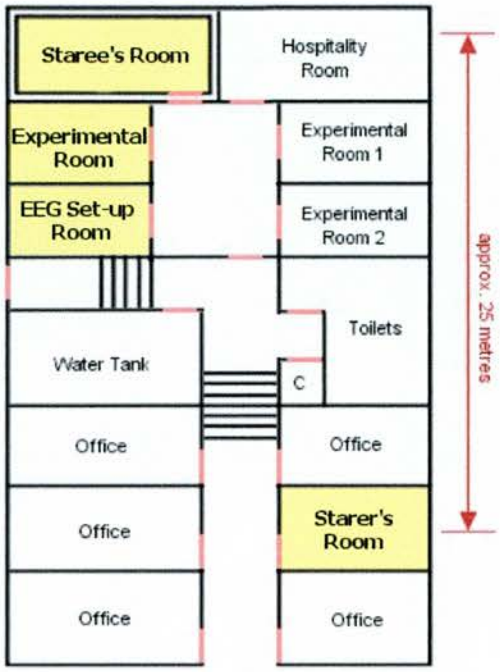

Figure 6.2: Schematic of the testing facility

of people staring at them, and at random intervals the experimenter (i.e., the starer) would be staring at them via a computer controlled video camera. It was explained that during this time, the participant should relax as much as possible and recordings of their brain and skin activity would be taken in order to see how they physiologically react to the images and being stared at. Any questions the participants had were answered, and the experimenter verified that they still wanted to participate.

The participants were asked to complete a short questionnaire asking general information about them (e.g. age, sex, possible skin allergies, last exposure to stimulants/depressants), followed by the SCS and the paranoia questionnaire (labelled 'Questionnaire One & Two' respectively) which were described as 'personality questionnaires'. They were allowed to complete these questionnaires on their own, while the experimenter was in the room next door, to ensure that the presence of the experimenter did not artificially alter any of the responses given (such as the experimenter making the person more nervous). The participants were then encouraged to vigorously brush their hair with a sterilised hair brush in order to lightly abrade the scalp and so help lower the EEG electrode impedances. The skin conductance (SC) electrodes were then applied as outlined in section 6.2.2.2 on page 115.

The participant's skin around their eyes and on their ear-lobes was then lightly abraded using an abrading solution (NuPrep ECG/EEG abrasive skin prepping gel) in order to reduce the impedance levels for the electroculargram (EOG) electrodes and the EEG reference electrodes. The EOG electrodes were then fitted using QuickGel (NeuroMedical Supplies Quick-Gel) and MicroPore tape. The vertical EOG electrodes, *VEOG+* and *VEOG-*, were fitted above and below the right eye respectively. The horizontal EOG electrodes, *HEOGR* and *HEOGL*, were fitted to the right and left-hand sides of the left eye respectively.

The EEG quik-cap was then fitted, ensuring that it was fitted correctly and the electrode positions matched the 10–20 system (Jasper, 1958). In order to provide a tight fit, elasticated bandages were used on occasion in order to prevent any 'bubbling' of the surface of the cap. The ear reference electrodes were fitted, and the cap electrodes were then all infused with QuickGel. The cap impedances were then all checked, and the impedances reduced where necessary.[7] The SC electrodes were reconnected and the participant was made as comfortable as possible. The participant was reminded about the procedure, and asked to keep movements to a minimum if possible. They were asked to try and relax, to look at the screen, and to have a 'gentle mental wish for the experiment to succeed'. The participant was then told that if they encountered any problems during the experiment, they should wave at the camera and the experimenter would stop the experiment. They were reminded that the experiment would last approximately 30 minutes. Any final questions they might have had at this point were answered, and the doors to their room shut. The EEG machine was then set to record, and the experimental program was started, which began to run the sequence outlined in section 6.2.2.1 on page 112. The experimenter then locked the experimental room and went to the starer's room, where he acted as the remote starer during the random schedule dictated by the computer.

Once the experimental session had finished, the experimenter unlocked the experimental room and stopped the EEG machine recording. The experimenter then returned to the participant and removed the EEG quik-cap and the other electrodes. The participants were then encouraged to remove the electrode gel from their hair and skin. They were then briefly shown what their EEG trace looked like, and they were reminded of the aims of the experiment. They were also told that the questionnaires that they completed were investigating their degree of paranoia and self-consciousness. Any questions they had were answered, and they

[7]Impedance reduction is no longer as critical an issue that it once was, thanks to the high input impedances of modern digital amplifiers (Ferree et al., 2001; Allen, Coan, & Nazarian, 2004). For example, the input impedance of the NuAmps system is 80MΩ (Neuroscan, 2003a).

were informed that they would receive details on the findings of the experiment once the data analysis was completed. They were finally escorted out.

6.2.4.1 Experimenter/starer's attitude during the experiment

During the setting-up of the equipment (i.e., attaching the EEG-cap, etc), the experimenter attempted to maximise the rapport between himself and the participant. The purpose of this was threefold: (a) it is good experimental practice in general, and (b) it is particularly important to continually reassure participants due to the potentially stressful and dehumanising nature of technologically-oriented experiments. Finally, (c) previous researchers have noted the importance of the relationship between the experimenter/starer and the staree in remote staring detection experiments (Braud et al., 1993a, 1993b; Watt et al., 2002).

During the experimental sessions the starer attempted to focus intently upon the staree when the video-feed was active, and project a mental will for the staree to detect the remote stare. Due to the length of the experimental sessions, and the large number of staring periods compared to previous remote staring experiments, the starer occasionally interspersed these intense periods of focus with more passive and relaxed remote staring. During the no-stare periods when there was no video-feed, the starer attempted to relax, to not focus on the monitor and to not think about the staree in any way. The starer attempted to have a positive mental attitude throughout the experimental sessions and to also have a 'gentle mental wish for the experiment to succeed' in general.

6.3 Pilot Study

6.3.1 Details

Because this experiment was employing methods of analysis that have never previously been used to research the phenomena under examination, it was necessary to conduct pilot work in order to identify the optimal and most flexible method for collecting the data. Three participants were used during the pilot study, and the alterations made to the method are outlined below.

6.3.2 Changes made to the method

The method had several changes to it prior to the main experiment. Originally, the stimulus epochs were set to 10000ms duration, with a 5000ms rest period following each epoch. This would have made the epoch duration more consistent with the 30 second epochs which have been used in previous remote staring experiments (e.g., Braud et al., 1993a, 1993b). However, participants in the pilot study complained about the length of the experiment, and therefore the stimulus epochs were decreased to 5000ms followed by 5000ms rest periods. This reduction would help to minimise any potential decline effects in the stimulus responses due to boredom effects in the participants.

Procedural changes were made to ensure that the skin conductance electrodes were fitted at the earliest possible opportunity. This meant that they had approximately 30 minutes to provide the optimal connection to the skin of the participant, allowing the skin the maximum possible amount of time to acclimatise to the electrode gel (as recommended by Fowles et al., 1981).

The completion of the questionnaires was moved to the beginning of the experiment. Initially, in order to reduce the experiment duration, it was intended for the participants to complete the questionnaires during the application of the EEG Quik-Cap. However, during the pilot study it was observed that participants obviously appeared nervous and self-conscious during the cap application, mainly because most participants had never experienced EEG measurement before, and this may have artificially inflated the results of the questionnaire measures.

6.4 Results

The data from the experiment was analysed using the Edit package of the NeuroScan Scan 4.3 (and 4.3.1) EEG processing suite, SPSS 11 (11.0.1) and the R environment (Version 1.9.0) for data manipulation, calculation and graphical display. Perl and Tck/TL scripts were used to extract the data, and examples of these can be seen in Appendix B on page 254.

6.4.1 System Latency Test

The system which was being used was designed specifically to carry out parapsychology experiments. Because of this, before the experiment could be conducted it was necessary to understand the limitations of the system, and most particularly the *system latency*. All EEG systems have a latency of some kind, representing the time it takes for a signal or stimulus transmitted from the control computer to being presented on the screen that the participant will be looking at. This problem was highlighted in guidelines published by the *Society for Psychophysiological Research* as follows:

> "If the stimulus is presented on a video display, there may be some lag between the trigger and the occurrence of the stimulus when the raster scanning reaches the location of the screen where the stimulus is located. If the trigger is locked to the screen refresh rate, this lag will be a constant fraction of the refresh rate."
>
> (Picton et al., 2000, p.136)

As the control computer also sent a *trigger stimulus* to the EEG machine at the same time in order to mark the EEG trace, any significant latency inherent in the system might have resulted in incorrect conclusions being drawn from the results. Although the latency can often be measured in milliseconds and may have little impact on EEG results in general, any ERP calculations that were extrapolated from this data may represent results different from the actual cortical behaviour as they are measured in the millisecond domain. For example, if the latency of a system is unknown, an apparent positive deflection at 150 milliseconds might be concluded to represent a 'P150', when in reality the system latency combines to make this effectively a P170, as it may take 20 milliseconds for the signal to be processed by the computer system. It was therefore vital that the latency of this unique system was known in case it represented a significant confound variable in ERP calculations.

In order to calculate this latency, a photoelectric diode was attached to the bottom right-hand corner of the participant's monitor. It was attached here in order to ensure that the full screen had refreshed before a signal was sent to the EEG machine. It was then connected to the test channel of the EEG system amplifier. Two screens were then sequentially projected to the participant's screen; one pure white, one pure black. This was repeated 1000 times (sample rate at 500Hz, which was the sample rate of experiment), and an average of the repetitions generated was taken, across all electrode sites.

6.4.1.1 Results of the latency test

The system latency can be seen clearly in figure 6.3 below. The *butterfly plot*[8] prior to 0 milliseconds (stimulus onset) represents background system activity, the screen was changed from black to white at 0ms (with the trigger signal being sent at this time), and the system latency is reflected by the maximum positive deflection of 4.5μV at 17ms.

[8] A *butterfly plot* shows all of the channels plotted on the same graph.

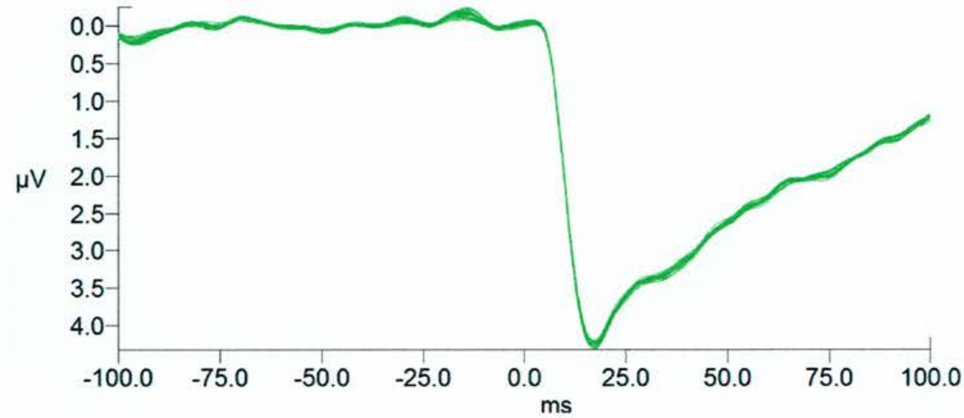

Figure 6.3: Graph showing system latency response to screen refresh

The results of this test suggest that any analyses conducted on data from this system are subject to a 17ms latency. For many analyses, this is of little consequence, but it can prove important when estimating the latency of a particular effect, particularly in ERP and similar event-driven analyses.

6.4.2 Data Preparation for ERP analysis

Prior to the analysis, the EEG data was pre-processed in order to remove artefacts. Initially a linear derivation was conducted in order to convert the monopolar ocular channels into bipolar channels. The data then had ocular artefacts removed using the bipolar vertical electrooculargram channel, with 30 sweeps at 400ms derivation, with a positive trigger at 10% threshold. The data was then visually inspected, and bandpass filtered with a high filter of 1Hz with a 24dB/oct rolloff, and a low filter of 30Hz with a 24dB/oct rolloff. The data was then epoched into all four conditions[9], with an epoch length of −100ms to +500ms. A baseline correction was performed to baseline to the pre-stimulus period.

Artefact rejection was then conducted using a minimum threshold of $-100\mu V$ to $+100\mu V$, followed by a visual inspection of the data. The data was then averaged according to the different conditions. It was only at this final stage that the data was treated in the separate conditions; all conditions were treated simultaneously prior to this in order to have blind treatment of the data.

[9] All of the conditions were subjected to artefact rejection simultaneously in order to prevent particular conditions from being treated differently than others, which could artificially inflate any potential effects.

6.4.2.1 Alpha correction for familywise error

Due to the number of comparisons being made in the different forms of analysis for the experiment, it is necessary to correct for familywise error (FWE) as the more comparisons that are run, then the likelihood that one or more comparisons are significant just due to chance (i.e., a Type I error) increases. It is common to alter the alpha level of the comparisons using the Bonferroni method (Howell, 1997), and the formula is as follows:

$$\alpha_B = \frac{\alpha_{FWE}}{c} \tag{6.1}$$

Where α_B is the new alpha level based on the Bonferroni test, α_{FWE} is the familywise error rate, and c is the number of comparisons.

However, the Bonferroni correction assumes the data is orthogonal (i.e., independent and nonoverlapping) which is rarely the case with psychophysiological data, particularly EEG, which often involves analysis of multiple peaks of interest that are naturally going to demonstrate a high degree of relationship to one another. Because of this, and the subsequent increased risk of making a Type II error, Russel (1990) strongly advocates not employing the standard Bonferroni correction on the analysis of psychophysiological data. Instead, Russel (1990) argues that a modified Bonferroni procedure should be used based on the work of Keppel (1982). Keppel's (1982) formula is as follows:

$$\alpha_{MB} = \frac{df_A(\alpha_{EC})}{c} \tag{6.2}$$

Where α_{MB} is the Modified Bonferroni, df_A is the degrees of freedom from the ANOVA, α_{EC} is the usual alpha level (i.e., usually .05), and c is the number of comparisons. This test can also be used with other statistical analyses. For example, df_A can also represent the number of variables used in a group of correlation tests, and c represents the number of correlations in the correlation matrix. The Modified Bonferroni correction is conducted for separate form of analysis, as they are effectively different measures.

However, there is also a strong argument that Bonferroni corrections of the alpha level are overly conservative and can result in a reduction of overall power and the increased likelihood of committing a Type II error, as equally as problematic as a Type I error (Bland & Altman, 1995; O'Keefe, 2003; Tutzauer, 2003). This is particularly problematic for the correlation of questionnaire variables as such measures are generally highly intercorrelated.

In order to accommodate all of the issues above the statistics used on the physiological variables (e.g., the EEG and SC measures) were tested against alpha levels corrected using the modified Bonferroni procedure, but other measures, such as the questionnaires, were tested using an unmodified alpha level. This provided a more stringent test of significance for the physiological measures that were specifically testing for a potential and controversial 'paranormal' effect, but also helped to alleviate the possibility of a Type II error on the questionnaire measures.

6.4.3 Hypothesis testing

6.4.3.1 Global field power analysis

The initial problem when analysing ERP data from a novel phenomenon is how to attempt to run a peak detection? All participants and all conditions will demonstrate a certain degree of variability regarding significant peaks of interest, depending on the specific cortical activity of individuals, and the different areas of cortical interest, and the different types of stimuli that participants are exposed to. The most conservative method of peak detection is to average together the data of all of the participants, and of all the stimuli, into the same waveform.[10] This is a highly conservative method of examining the data, and it will obviously eliminate any subtle or weak effects, as it essentially shows all participants, all electrodes and all stimuli in one waveform, but it does offer the most temporally accurate data. This overall view of the temporal information for peak detection can be seen in figure 6.4.

As can be seen from this overall waveform in figure 6.4, the peaks of interest are at 134ms, 222ms and a slower peak from 378–500ms.[11] The means and standard deviations of these peaks of interest are shown in table 6.2. Once the peaks had been ascertained, the differences between conditions could be assessed, as per the hypotheses. Due to the relatively high amplitude ERP generated by the face-stimuli (i.e., the face condition and the face + remote stare condition), comparisons between the face-stimuli and the non-face-stimuli have to be treated

[10]Thanks to Professor Dietrich Lehmann for suggesting this method (Lehmann, 2004, *Personal Communication*).

[11]Unlike the two earlier peaks, the 378–500ms epoch did not have a clear and distinct peak. Because of this, and as the two waveforms displayed fluctuations between one another, an *area-under-the-curve* (as opposed to a mean) measure was used in this analysis. Because of this use of a different measure, the means and standard deviations shown in table 6.2 are substantially different for this peak compared to the others.

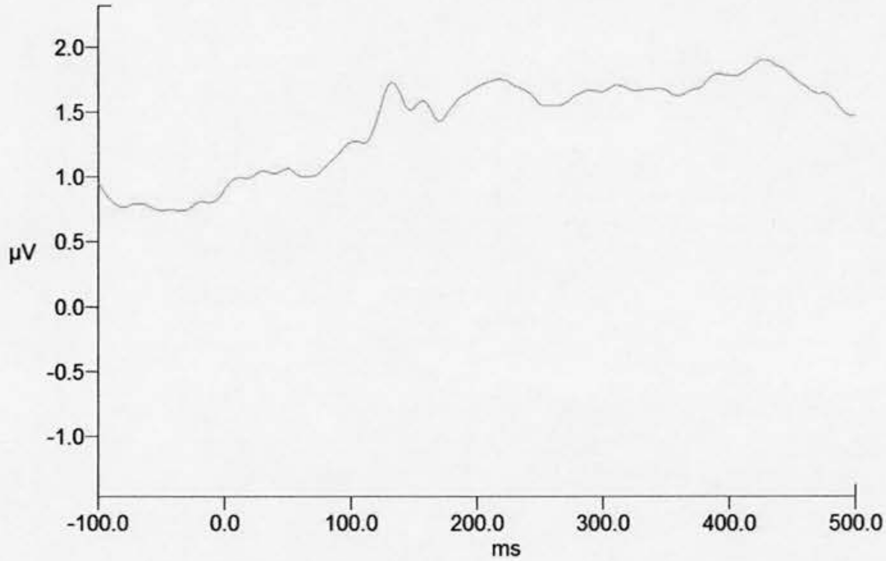

Figure 6.4: Overall GFP of all participants and all conditions

with caution. This distinction, as well as the waveform differences between conditions in general, can be seen in figure 6.5.

Condition	*134ms*		*222ms*		*378–500ms*	
	Mean (μV)	SD	Mean (μV)	SD	Mean[a]	SD
Face	2.38	.85	2.37	.97	267.89	76.80
Face + Remote Stare	1.88	.71	1.96	.84	267.97	77.29
Remote Stare	1.33	.54	1.29	.45	163.44	72.27
Control	1.25	.45	1.29	.41	149.81	42.74

[a]The *extended trapezoidal rule* is used to calculate the area under the curve. This effectively results in the summation of all points within the time-frame and multiplying this by the sample interval (Neuroscan, 2003b, p. 131–132). Therefore the mean values presented here are not directly equivalent to μV units.

Table 6.2: Means and standard deviations of the GFP values for the three peaks of interest for the four experimental conditions.

In figure 6.5, the conditions 'Face' and 'Face + Remote Stare' represent the two conditions where a participant was exposed to the picture of a face, the only difference being that in the latter condition, the participant was also being stared at remotely.

When the GFP values for the different conditions and epochs was tested using the Shapiro-Wilk test (which tests for normality for cases less than 50), it was found that several of the GFP values were significantly non-normal in their

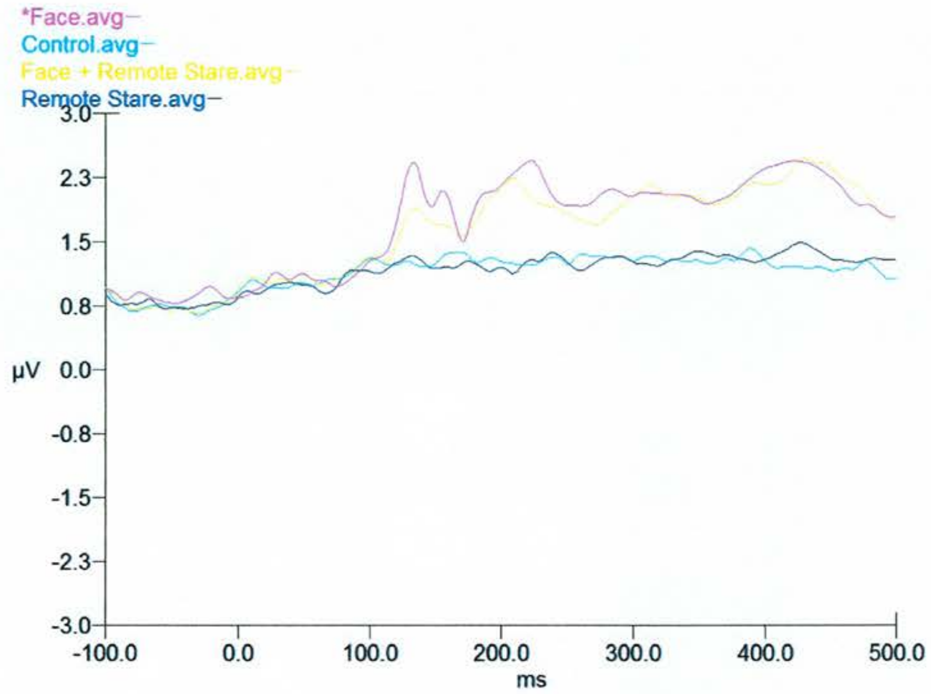

Figure 6.5: GFP of all participants and all four separate conditions

distribution and therefore non-parametric statistics were used to analyse the data. Because of this, the use of the modified Bonferroni correction as outlined in section 6.4.2.1 could not be used as they are optimised for use with parametric measures (see Russel, 1990). Therefore, the alpha level for the Wilcoxon Signed Ranks tests was adjusted to take into consideration that analyses on three separate regions of interest were being conducted[12], resulting in a modified alpha level of .01.

A Wilcoxon test between the 'Face' condition and the 'Face + Remote Stare' condition demonstrated that there was a significant GFP amplitude difference in both the 134 peak ($T = -2.875$, $p = .004$) and the 222ms peak ($T = -2.427$, $p = .01$). These effects, and their relationships to cortical surface activity, can be seen more clearly in the topographic maps of the subtracted peak activity shown in figure 6.6. In figure 6.6, the activity of the 'Face' condition has been subtracted from the 'Face + Remote Stare' condition, which means that the activity that these topographic maps reflect is theoretically due to the effect of remote staring. There was no significant effect between the two conditions for the 378–500ms area ($T = -.037$, $p = .970$).

A similar Wilcoxon Signed Ranks Test between the 'Remote Stare' and the

[12]This is similar to the alpha adjustment for the ANOVAs conducted on each peak of the GFP data in experiments two (see section 7.3.3.1) and three (see section 8.3.3.1).

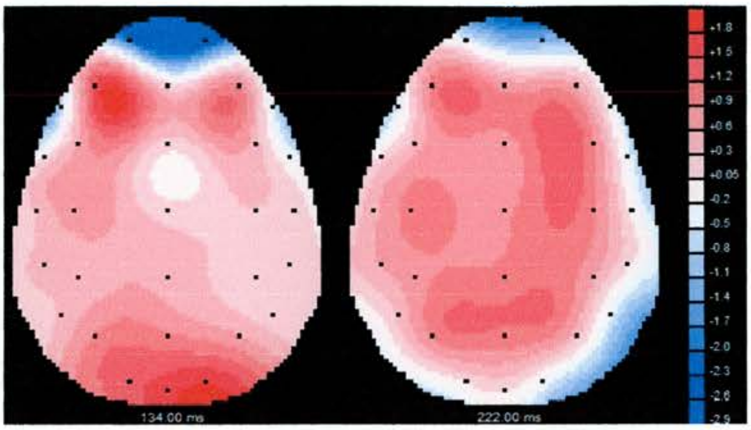

Figure 6.6: Topographic map of subtracted remote staring activity for the 134ms and 222ms peaks

'Control' conditions did not reveal a significant GFP amplitude difference in either the 134 peak ($T = -.597,\ p = .550$), or the 222ms peak ($T = -.299,\ p = .765$), or the 378–500ms area ($T = -.224,\ p = .823$).

Although the results have to be treated with caution due to the difference in stimulus types, an analysis was conducted between the face-perception condition (i.e., the 'Face' condition) and the control condition, in order to demonstrate that there was a definite effect on cortical activity of displaying a face. A Wilcoxon Signed Ranks test between the 'Face' condition and the 'Control' condition demonstrated that there was a significant GFP amplitude difference in the 134 peak ($T = -3.808,\ p < .001$), the 222ms peak ($T = 3.92,\ p < .001$), and the 378–500ms area ($T = -3.883,\ p < .001$).

Summary of GFP/ERP Results: The results indicate that there was a significant amplitude difference in the peak GFP between the face and the face and remote stare conditions for the 134ms and 222ms peaks, but not for the 378–500ms area. Due to the inconclusive findings of the 378–500ms area, and the difficulty in defining this component compared to the peaks, future studies should concentrate their analysis on the more clearly defined peaks at the earlier stages of processing, particularly as the 134ms and 222ms peaks broadly correspond to face-specific processing noted in the literature (e.g., Itier & Taylor, 2004).

6.4.3.2 Skin conductance analysis

Unfortunately, an equipment failure resulted in a random number of data-points from the skin conductance measure for each trial and for all participants being lost. As this resulted in each dataset being corrupted beyond recovery, the skin conductance data from all participants had to be discarded.

6.4.3.3 Questionnaire analysis

A series of non-parametric Spearman's rho correlations were used to compare the SCS questionnaire measures and the non-clinical paranoia questionnaire measures. As expected, there is a high degree of correlation between the three main factors of the SCS questionnaire, and their component factors. As such relationships have been discussed in previous literature, they have been omitted here. Several of the other questionnaire measures correlated significantly with one another and they are summarised in table 6.3.

Measures	r coefficient	Significance level (p)
Self-Reflectiveness & Internal State Awareness	.69	.001
Private Self-Consciousness & Non-Clinical Paranoia	.46	.04
Self-Reflectiveness & Non-Clinical Paranoia	.44	.05
Public Self-Consciousness & Social Anxiety	.48	.03
Appearance Consciousness & Style Consciousness	.49	.03
Social Anxiety & Appearance Consciousness	.49	.03

Table 6.3: Summary of the significant correlations between the questionnaire measures

The subtracted GFP peaks between the 'Face' and 'Face + Remote Stare' for peaks 134ms and 222ms were compared to the SCS and Non-Clinical Paranoia measures, but there were no significant correlations between the GFP measures and the questionnaires. A split-half correlational analysis between the highest amplitude GFP measures for the 134ms peak, and 222ms peak, for the 'Face' condition demonstrated that there were no significant correlations between the amplitude of face-processing and the questionnaire measures.

6.4.4 *Post-hoc* analysis

6.4.4.1 Further ERP analysis

Examining the remote staring effect: In order to examine the nature of the remote staring effect in more detail, further analysis was conducted based upon the subtracted topography of the remote staring effect shown in figure 6.6. It is a common procedure in ERP studies to demonstrate significant deviations in the distributions of the scalp topography in order to show the nature of the effect under analysis (Russel, 1990). In this analysis, the topography for the 134ms peak appears to demonstrate a negative component in the anterior region, a neutral component along the midline, and a positive component in the posterior region. The topography for the 222ms peak again also demonstrates a negative component in the anterior region, and a neutral component for the midline, but a mixed picture of positive and negative elements in the posterior region. In order to examine if the differences between these components were significant, a series of 3 × 3 (Condition [Face, Face + Remote, Control] × Position [Anterior, Midline, Posterior]) repeated measures ANOVAs were conducted on the data.[13] Several electrodes were averaged together in order to provide measures of the anterior, midline and posterior regions, and these are summarised in table 6.4. The means and standard deviations of the ERP values for the different conditions by the three different positions are shown in table 6.5 for the 134ms peak, and in table 6.6 for the 222ms peak.

		Hemisphere		
		Left	Midline	Right
	Anterior	Fp1	Fz	Fp2
Location	Midline	C3	Cz	C4
	Posterior	O1	Oz	O2

Table 6.4: Electrodes used in ANOVA analysis

For the analysis of the 134ms component, summarised in table 6.7, the Mauchly's W test revealed that at least one of the ANOVA's factors is significant and sphericity is not assumed, a finding verified by the high Greenhouse-Geisser ϵ and Huynh-Feldt ϵ values, and therefore the Greenhouse-Geisser correction needs to be administered to the analysis. This analysis is essential as psychophysiological data is rarely homogeneous, and a failure to correct for it can result in an inflation of the Type I error rate, an issue that has been

[13]Modified alpha for this analysis was calculated as: $\alpha_{MB} = .025$

Condition	*Anterior*		*Midline*		*Posterior*	
	Mean	SD	Mean	SD	Mean	SD
Face	-2.65	2.02	-.89	1.05	3.84	2.47
Face + Remote Stare	-1.03	1.62	-.97	1.07	2.64	2.19
Control	-.28	.99	.04	.76	.42	1.17

Table 6.5: Means (in μV) and standard deviations of the ERP values for the 134ms peak for the three topographical positions and the three conditions under analysis

Condition	*Anterior*		*Midline*		*Posterior*	
	Mean	SD	Mean	SD	Mean	SD
Face	-1.01	1.36	1.89	1.79	-2.01	2.61
Face + Remote Stare	-.46	1.17	1.55	1.45	-1.76	2.17
Control	.09	.90	-.09	.61	.34	.97

Table 6.6: Means (in μV) and standard deviations of the ERP values for the 222ms peak for the three topographical positions and the three conditions under analysis

commented upon in the literature (Jennings & Wood, 1976; Vasey & Thayer, 1987; Russel, 1990). However, it should also be noted the test for sphericity, and the subsequent potential Greenhouse-Geisser correction, is only applicable to repeated-measures ANOVAs with degrees of freedom greater than 1 (Tabachnick & Fidell, 2001, p. 421).

Within Subjects Effect	Mauchly's W	Approx. χ^2	*df*	*p*	Greenhouse-Geisser ϵ	Huynh-Feldt ϵ
Condition	.819	3.601	2	.065	.847	.920
Position	.667	7.298	2	.026	.750	.800
Condition* Position	.382	16.773	9	.053	.722	.865

Table 6.7: Mauchly's Test of Sphericity for 134ms Peak Electrodes

In the ANOVA, there was not a significant effect for condition ($F_{1.693,32.168} = .650, p = .504$), but there was a significant effect for position ($F_{1.500,28.501} = 44.526, p < .001$), and a significant interaction between condition and position ($F_{2.888,54.870} = 18.635, p < .001$). The nature of this interaction can be seen in figure 6.7, and the tests of within-subjects contrasts verified that the relationship was linear ($F_{1,19} = 39.893, p < .001$), driven primarily by the effect of position ($F_{1,19} = 57.375, p < .001$).

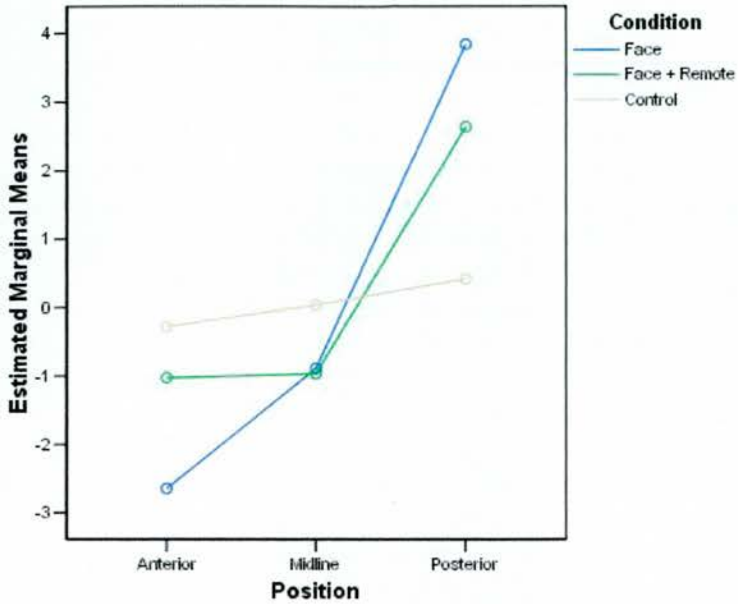

Figure 6.7: Factor interaction plot for the 134ms peak analysis

Similar to the analysis of the 134ms component, the Mauchly's W analysis of the 222ms component, summarised in table 6.8, suggested that at least one of the ANOVA's factors is significant and again sphericity is not assumed. This finding is again verified by the high Greenhouse-Geisser ϵ and Huynh-Feldt ϵ values, and therefore again the Greenhouse-Geisser correction needs to be administered to the analysis.

Within Subjects Effect	Mauchly's W	Approx. χ^2	*df*	p	Greenhouse-Geisser ϵ	Huynh-Feldt ϵ
Condition	.754	5.081	2	.079	.803	.865
Position	.432	15.125	2	.001	.638	.663
Condition* Position	.095	40.975	9	<.001	.547	.621

Table 6.8: Mauchly's Test of Sphericity for 222ms Peak Electrodes

In the ANOVA, there was a significant effect for both condition ($F_{1.605,30.500} = 5.719, p = .012$) and for position ($F_{1.275,24.228} = 14.533, p < .001$), and there was also a significant interaction between condition and position ($F_{2.188,41.576} = 13.193, p < .001$). The nature of this interaction can be seen in figure 6.8, and the tests of within-subjects contrasts verified that the relationship was different to the 134ms peak in that it was quadratic ($F_{1,19} = 15.485, p = .001$), driven primarily by the effect of position ($F_{1,19} = 24.742, p < .001$).

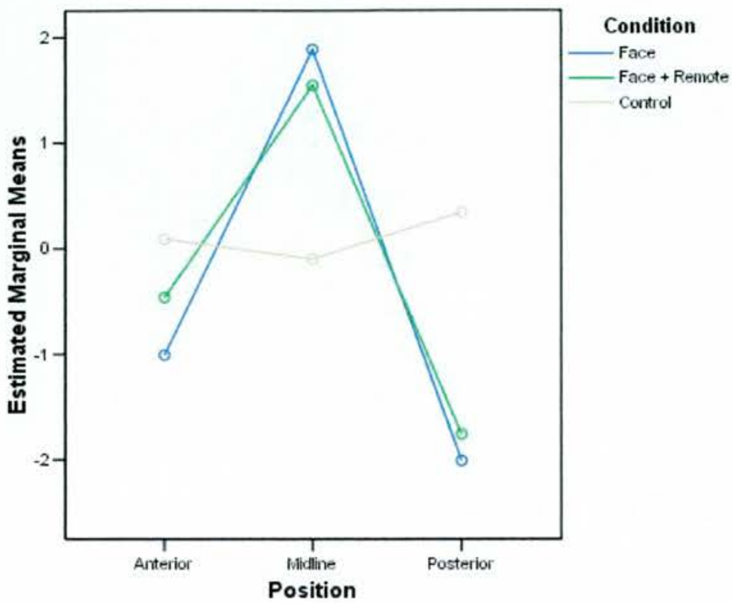

Figure 6.8: Factor interaction plot for the 222ms peak analysis

This analysis suggests that there is a significant difference in the topographical distribution of the effect, but it is unclear what the nature of the effect is, as the inclusion of the control condition, which is necessary in order demonstrate that there is a significant effect of faces in general, is contributing to the significant interaction effects. The ANOVAs statistically support what the topographies for each peak are suggesting: that the 134ms peak shows a linear effect with a negativity at the anterior, spreading to a positivity at the posterior, and the 222ms peak shows a quadratic effect, with a negativity at the anterior and posterior, and a positivity at the midline.

The lack of a significant difference between the conditions in the 134ms peak analysis suggests that there is not a significant difference between the face and the face + remote stare conditions for this analysis. The significant difference between conditions in the 222ms peak analysis is due to the control condition demonstrating a quadratic effect, and is not due to differences between the face and the face + remote stare conditions. The fact that this analysis is not detecting a difference between the face and face + remote stare conditions argues in favour of the global effect of the remote stare which can be seen in the scalp topographies. The global field power measure is picking up on the positive and negative components from all over scalp as it includes the data from all recording electrodes regardless of valence, whereas this analysis is too selective for such a distributed topography.

Although this form of analysis is useful for examining highly localised effects, the distributed nature of this effect does not lend itself well to this type of analysis, and in fact these results merely serve to confuse the picture. Future studies should concentrate on the global field power measure, as it is (a) a more conservative approach, and (b) it contains information from all of the measuring electrodes and, by its very nature, can neatly encompass distributed topographical information.

6.4.4.2 Frequency analysis

Although the event-related potentials demonstrate a significant effect, they are only examining a small proportion of the total time in which participants were exposed to the different stimuli. There is a full 4500ms of data which has not been examined. However, as ERPs focus on the activity surrounding the initial processing of the stimuli, it would be inappropriate to use ERP methods to analyse the full data duration of 5000ms. A more appropriate method, which provides subtly different information, is fast-fourier transforms (FFTs). In order to see how the effects of the different stimuli change over time, FFTs were performed for each condition on the first five, one-second epochs after stimulus onset. The Alpha (α) band was chosen as the main frequency band of interest as face-processing represents a desynchronisation of α activity compared to the α activity which should be identified in a resting state (i.e., the 'Control' condition). The α activity over the four conditions averaged over all participants can be seen in figure 6.9. There is considerably less α activity in the conditions in which there was a face (i.e., 'Face' and 'Face + Remote') when compared to the non-face conditions (i.e., 'Remote' and 'Control'), which is to be expected as the face-processing effect should be represented in a frequency analysis of EEG as an α desynchronisation. This is particularly apparent in the drop in α power after two seconds of exposure to the face-stimuli. This effect may or may not be due to the processing of faces in particular, or just due to the processing of an image on the screen. This issue can only be resolved by further experimentation.

A 4×5 factor ANOVA (conditions $\times$ time [seconds] was used to analyse the data, and a Mauchly's W analysis was significant (see table 6.9), suggesting that sphericity cannot be assumed and that the Greenhouse-Geisser correction needed to be applied to the ANOVA. The ANOVA revealed a difference that was approaching significance between the α power of the different conditions

Within Subjects Effect	Mauchly's W	Approx. χ^2	*df*	*p*	Greenhouse-Geisser ϵ	Huynh-Feldt ϵ
Condition	.122	37.344	5	<.001	.459	.483
Time	.238	24.973	9	.003	.608	.704
Condition* Time	<.001	171.924	77	<.001	.346	.454

Table 6.9: Mauchly's Test of Sphericity for the alpha FFT analysis of all four conditions

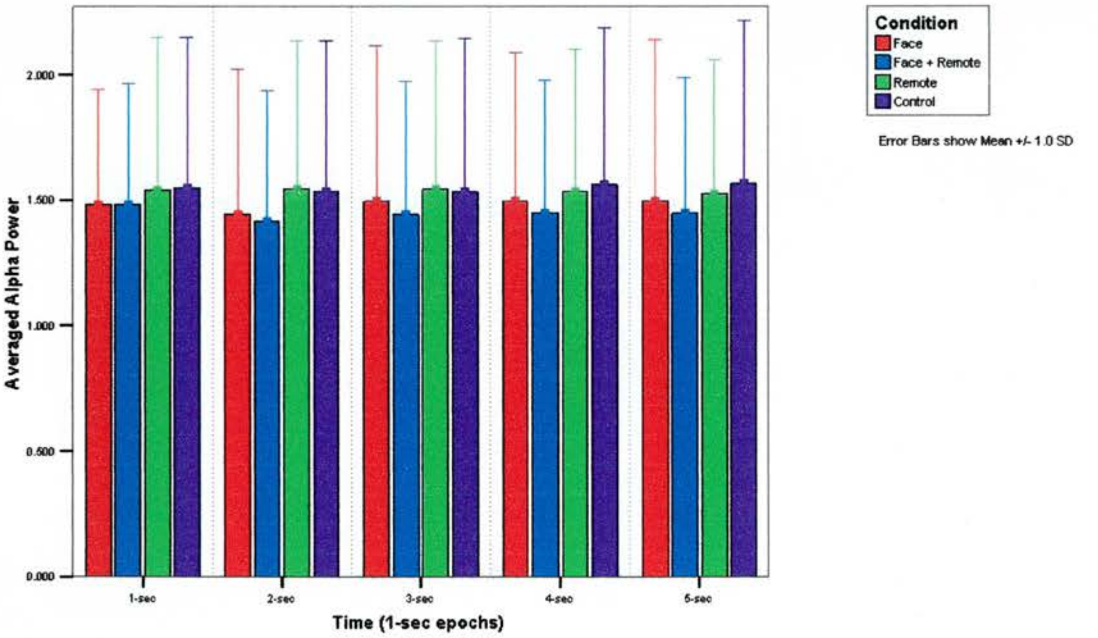

Figure 6.9: Averaged α power for all participants for the four conditions over the 5 second stimulus duration

($F_{1.316,26.139} = 3.395, p = .065$), but no differences over time ($F_{2.431,46.197} = 1.526, p = .225$).

Within Subjects Effect	Mauchly's W	Approx. χ^2	df	p	Greenhouse-Geisser ϵ	Huynh-Feldt ϵ
Condition	—	—	0	—	—	—
Time	.189	29.035	9	.001	.629	.733
Condition* Time	.428	14.768	9	.099	.705	.841

Table 6.10: Mauchly's Test of Sphericity for the alpha FFT analysis of the 'face' and the 'face + remote' conditions

A second 2 × 5 factor ANOVA (conditions × time [seconds]) was conducted, concentrating on the two 'face' conditions. Similar to the above analysis, a Mauchly's W analysis was significant (see table 6.10), suggesting a lack of sphericity in at least one of the factors and that the Greenhouse-Geisser correction needed to be applied to the ANOVA. The ANOVA demonstrated a difference between the α power of the 'Face' and the 'Face + Remote' conditions that was approaching significance ($F_{1,19} = 3.807, p = .06$), and there was no significant differences over time ($F_{2.516,47.806} = 1.020, p = .382$).

The differences between the α power of the different conditions are probably due to the α desynchronisation present in the face conditions, compared to the non-face conditions, as participants are actively processing the face stimuli and their background α activity decreases. However, it would appear that the addition of a remote stare creates a greater degree of α desynchronisation to face processing, although this effect was only approaching significance.

6.4.5 Summary of all results

This study suggests that there is a significant difference in cortical processing during the face + remote stare condition compared to the face only condition. The main evidence of this effect is from the use of global field power (GFP), which demonstrated that the introduction of a remote stare appeared to have an impact on the amplitude of the face processing effect, and effectively reduced the amplitude of the peaks commonly associated with face processing. Further *post hoc* analyses concerning the nature of the remote staring effect were inconclusive due to the global nature of the effect. An analysis of the longer epoch duration of the entire time that the participants were exposed to the stimuli demonstrated that face processing, with the addition of remote staring, had a greater effect on averaged α desynchronisation that was approaching significance when compared with face processing on its own.

With regard to more straightforward face processing, the GFP analysis demonstrated that it was occurring, and was broadly comparable to the face processing noted in the previous literature. These findings were supported by the α desynchronisation over the 5-second epoch that the faces were on the screen, although this difference was only approaching significance. However, it is unclear whether or not this was a face processing effect *per se*, or a reaction to a stimulus on the screen when compared to a blank screen.

The SCS and paranoia questionnaires demonstrated some intercorrelations, but did not show a relationship with the psychophysiological measures.

6.5 Discussion of experiment one

This study represents the first examination of the cortical electrophysiology related to remote staring processing, and as such has had to contend with unique practical issues. However, the study has found evidence which suggests that remote staring detection may have an impact upon the cortical activity associated with face processing, both with the use of conservative GFP measures and with additional *post hoc* analyses. The findings also suggest that this effect is very rapid and does not appear to involve a gradual build-up, indicating a rapid physiological *detection onset*. Although there are challenges to this new line of research, most significantly the issue of replicating this effect, it does offer a new and exciting method of evaluating a particular parapsychological phenomenon as a cortical event, and offers the possibility of the physicality of a parapsychological event.

The results presented suggest a unique and interesting phenomenon. The remote staring effect was only present during the administration of a face stimulus, and was not present when the remote stare was presented on its own. It is possible to refer to the previous parapsychological literature to demonstrate that a remote staring effect is possible on its own, but due to the fact that this was the first study to use EEG and the skin conductance data that might have been able to tie this study more definitively into the previous literature was a victim of a technical problem, then the previous literature provides little resolution to this issue. However, remote staring detection may not have necessarily occurred in isolation in previous studies. It is possible that previous successful remote staring studies asked the 'staree' to complete some sort of task that involved additional cognitive load during the measurement periods, tasks as complex as completing a questionnaire (e.g., Wiseman et al., 1995) through to simply staring at a screen-saver (e.g., Schlitz & LaBerge, 1997), which may provide an indication to why this effect does not occur on its own, but relies upon the modification of existing processes.

This suggestion would broadly fit into the anecdotal cases of remote staring. Although such cases need to be treated with caution due to their nature, and due to the tenuous link between them and the lab-based studies (for a further exploration of this issue, see section 3.5.3 on page 52), it is clear to see in many anecdotal cases that the individual experiencing the remote stare is generally involved in another task at the same time (such as walking down the street, talking to someone, etc), and looking at a blank screen is unstimulating at best. Indeed, although parapsychologists are required to measure parapsychological phenomena in isolation in order to ensure appropriate controls are in place, it seems unlikely that if parapsychological phenomena are genuine, they will be occurring in isolation. It is a far more efficient model if parapsychological information is being absorbed like any other source of environmental information in order to allow individuals to build the most complete model of their environment as possible. However, like many other sources of information, the brain must selectively attend to that information which is most pertinent to the situation and only make that available to consciousness. Otherwise we would simply be overwhelmed by information flow.

Therefore, the suggestion is that this remote staring effect represents a modification of cognitive processes. However, it is unclear whether or not this remote staring effect is due to the modification of any process, or that there is a particular feature of faces that makes the remote staring effect only modify the evoked-potentials of this type of processing. As has been discussed previously, one of the main reasons that faces were used as a stimulus was to explore the potential links between conventional face processing with the more abstract concept of remote staring detection. It is possible, therefore, that the reason why remote staring modulated the face processing effect was because it was drawing on the resources devoted to face processing, and that there is a special relationship between face processing and remote staring detection.

However, there is only one way to establish this. Further experimentation is required in order to test face processing with and without a remote stare, to see if this modulation is repeated, and the use of an object (such as a chair, etc) with and without remote stare to see if the same modification occurs. The face conditions would essentially be a replication of the study reported here, but if the remote stare also provided a modulation of the object processing as well, then it would suggest that this effect is not specifically tied to faces. If there was no effect of remote staring on objects, but there was on faces, then this would not just be a replication of this study, but it would suggest that there is a specific relationship between the processing of faces and remote staring detection. Conversely, if there was no effect of remote staring on faces, but there was on objects, or there was no effect of remote staring on either stimulus, then the interpretation would be more ambiguous. If it was an object only effect, and the face effect failed to replicate, it would produce a confusing picture that would need to be explored by further experimentation. A complete lack of replication would cast doubts upon the validity of the remote staring effect demonstrated in this study.

One of the issues of experiment one is that it because the 'Face' stimulus could only be compared to the processing of a blank screen, the conclusions that can be drawn with regard to the processing of faces are limited. This is because the differences in processing between the two stimuli may not necessarily be related to the processing of a face, but arise because there was a complex visual stimulus versus a blank screen. An experiment that incorporates a comparison of the processing of faces versus objects (without remote staring detection being a factor) allows for an assessment of the differences in face processing compared to object processing, which in turn provides evidence to demonstrate that the method is appropriate as such findings can be compared to previous research.

As with any novel study, particularly parapsychology studies, there is always the concern that a particular result might have been caused by an artefact. The significant differences between the 'Face' and the 'Face + Remote' conditions might merely represent a spurious result of some kind. However, the stimuli were randomised and counterbalanced for each session, and the system was set-up so that the video camera was on continuously and the only change was the lifting of a digital mask on the screen of the person doing the staring, making this unlikely. This issue can only truly be resolved by repeating the experiment and finding the same (or similar, due to potential population differences and the complexity of EEG) effect.

As has already been mentioned, the obvious experiment to follow on from this study is to replicate the effect and build upon it by examining the effects of remote staring on object processing. However, future work needs to go further than a straightforward effect of remote staring on face processing. There is also the issue of the effect of remote staring on α power. The α decrease in the face conditions is expected as generally faces would provide an α desyncronisation as they represent the processing of a cognitive event. Although the addition of a remote stare only provided an α decrease which was approaching significance, the effect was strong enough that it is necessary to investigate this further. This could be investigated using fast fourier transforms again, perhaps with the addition of examining other frequency bands, or by the use of *event-related band amplitude* (ERBA) analysis (as described in section 4.2.1.4 on page 84). ERBA analysis would allow frequency to be plotted over time, combining a number of the measures used in this study, but it would also provide information on the *phase locked* (i.e., evoked) and *non-phase locked* (i.e., induced) components of the EEG activity associated with processing a particular cognitive event. This method could help in the understanding of the complex and controversial remote staring effect that has been found in this study.

To summarise, the best possible way to verify that none of these issues introduced any artefacts into the experiment would be to replicate the results. This replication can be built upon by examining the effect that remote staring has on face stimuli and object stimuli, in order to test the specificity of the remote staring detection effect.

Chapter 7

Face Processing and Remote Staring Detection

7.1 Introduction

The results from the first experiment suggest that the electrocortical processing associated with the viewing of faces is significantly altered by the addition of a remote stare. However, these interesting results leave several issues in their wake. Firstly, because this represents the first time that remote staring detection has been examined with regard to the potential brain activity that might be associated with it, there is a strong need to replicate this effect. However, a straightforward replication might only provide minimal answers to the questions posed by the results of the first experiment, and it is necessary to not just replicate, but also build upon the evidence from the first experiment.

The results also suggest that remote staring detection has no significant cortical processing in its own right, but is measured by its impact upon other processes — in this case, face processing. One of the key elements of the first study was the attempt to examine any potential relationships between face processing, and the processing of a remote stare stimulus. However, the findings raised the question of whether or not there was something special about the processing of faces that allowed it to be susceptible to the impact of a remote stare or could other stimuli, such as objects, also be susceptible to this influence?

As was noted in Chapter 5, faces are processed significantly differently to objects. This processing is so markedly different that some researchers have suggested that faces represent a form of cortical domain specificity to a stimulus due to the social importance of faces to humans (e.g., Kanwisher, 2000; Carmel & Bentin, 2002; Bentin & Carmel, 2002). Other researchers disagree, arguing that this unique form of processing is merely indicative of increased exposure of practice and not a result of specific 'hard-wired' cortical structures (e.g., Tarr & Gauthier, 2000; Rossion et al., 2002; Tarr & Cheng, 2003).

The unique nature of the processing of faces potentially has important implications for the understanding of remote staring detection. If the processing of remote staring detection is associated or linked with the processing of faces, as suggested in Chapter 5 and by the findings of the last experiment, then it could provide evidence for the claim that remote staring detection is some form of 'extension' to, or anomaly of, normal staring processes. However, if remote staring detection also has a similar impact upon the processing of objects, then this is indicative of a process that is not specifically related to the processing of faces, but can have an effect upon other congruent processes in general. The additional advantage to comparing the effects of remote staring detection on face and object processing is that the processing of faces and objects alone can be compared, verifying that the effects are comparable with previous research and that the overall method is valid and appropriate.

It was also important in this study to examine the effect of remote staring detection on skin conductance activity. The measurement of skin conductance was performed in the last study but a technical problem meant that it was not possible to analyse the skin conductance data collected in the last experiment. This measurement of this activity will allow a comparison of the potential effects from this study to previous remote staring studies, going back to 1993 (Braud et al., 1993a), and analysed in Schmidt et al.'s (2004) meta-analysis. Although the questionnaires used in the last study did not correlate with the psychophysiological measures, they have been included in this study in order for them to be compared once again to the main GFP analysis, and more importantly to the skin conductance analysis, and also in order to keep the procedures between the different studies consistent. Further comparisons between the different questionnaire measures will not be conducted, as a high degree of correlation was observed in the previous study and in Fenigstein and Vanable's (1992) research, making further comparisons redundant.

7.2 Method

The method for this experiment was virtually identical to that used in the first experiment, as detailed in section 6.2 beginning on page 112. Instead of duplicating the information presented in section 6.2, this method section simply outlines any differences from the core method previously described.

7.2.1 Participants

The data from 20 participants (seven males and 13 females) who took part in this experiment are included in the analysis.[1] The average age was 25.3 years old (ranging from 20 to 38 years old). The participants were paid five pounds for taking part. All but one of the participants were right-handed, and were all either staff or students at the University of Edinburgh.

7.2.2 Materials & Equipment

Due to equipment upgrades in the testing laboratory, the experimental computer used in this experiment was slightly different to that used in the previous experiment. The experimental computer used in this experiment had an AMD Athlon XP 2800+ (2.08Ghz) processor, with 1Gb RAM, and was running Windows XP (Service Pack 1). It was connected to an experimenter's monitor (Elonex MT-17AES 17" LCD, connected via an Nvidia Geforce FX5700LE graphics card), a staree's monitor (Elonex MN017TCV 17" LCD, connected via an Nvidia Vanta graphics card), and a starer's monitor (Elonex MN017TCV 17" LCD, connected via an Nvidia Vanta graphics card) via standard 15-pin monitor cables. Connected to the experimental computer was a video-camera (Logitech QuickCam Messenger USB camera) which was 160cm directly in front of the staree, and the same skin conductance measuring equipment as used in the first experiment. The gel used with the skin conductance electrodes was a pH balanced electrode paste (Grass Telefactor Ec33 electrode paste — 0.5% saline in a neutral base — which was subtly different to that used in the first experiment). Skin conductance was measured in the same was as outlined in section 6.2.2.2 on page 115. The EEG computer and EEG system was the same used in the previous experiment. The software used to record the EEG data was the Acquire package of NeuroScan's Scan 4.3.1 EEG processing suite, which was a slightly upgraded version of the software used in the first experiment.

Although some of the equipment had been upgraded, it was all connected in the same manner as was outlined in section 6.2.2.1, and in the schematic shown

[1] 34 participants were tested during the course of the experiment. The data from 10 participants had to be removed from the analysis due to the system latency issue explained in section 7.3.1 on page 146. The data from an additional four participants had to be removed due to excessive noise artefacts. Additional participants were recruited as valid data from 20 participants were pre-specified as necessary before the experiment.

in figure 6.1 on page 114. In addition to this, the layout of the testing facility remained the same, as shown in figure 6.2 on page 118.

The program controlling the entire experiment was administering the following four conditions in a randomised and counterbalanced order:

- *Face condition* — In this condition the participant would see a picture of a face staring directly at them.[2] During this time the starer was looking at a black screen.
- *Face + Remote stare condition* — In this condition the participant would see the same picture of a face as the condition above, and the experimenter would see a live video feed of the participant.
- *Object condition* — In this condition the participant was presented with a picture of an object[3], and the experimenter was looking at a black screen.
- *Object + Remote stare condition* — In this condition the participant saw the same picture of the object as above, and the experimenter was presented with a live video feed of the participant.

The relationship between these conditions is more clearly evident in table 7.1.

	Face Displayed	Object Displayed
Remote Stare	*Face + Remote Stare Condition*	*Object + Remote Stare Condition*
No Remote Stare	*Face Condition*	*Object Condition*

Table 7.1: 2 × 2 table of the experimental conditions

In order to maximise the degree of raw data collected for off-line analysis, the EEG was sampled at 500Hz with increased 32-bit resolution, and had a high-pass filter at 0.5Hz, with no low-pass filter (apart from the maximum range set by the equipment, which is set at 262.5Hz, see Neuroscan, 2005) and no notch filter. Each condition was repeated 60 times in a randomised and counterbalanced order, and lasted for 5000ms followed by a 5000ms rest period. These measurement criteria

[2]The picture was the same picture as that used in the first experiment.

[3]The object was a picture of a chair taken from the *International Affective Picture Set* (IAPS) database (image code: 7235). It was rated on the following IAPS scales: Pleasure (mean = 4.96, SD = 1.18), arousal (mean = 2.83, SD = 2), dominance (mean = 6.53, SD = 2.09). A chair was used because evidence from previous work suggested that such an object might provide a more distinct difference in processing compared to faces than other objects (Itier & Taylor, 2004). This was confirmed by the researchers involved (Itier, 2004).

are slightly different to the first experiment due to differences in the analysis used in this experiment. The same personality questionnaires were administered as described in section 6.2.2.3 on page 116.

7.2.3 Hypotheses

The hypotheses for this experiment are outlined below:

1. There will be a significant difference in the skin conductance values between the face and the face + remote stare conditions, and between the object and the object + remote conditions.

2. There will be a significant difference in the global field power (GFP) peak amplitudes between the face and the face + remote stare conditions, and between the object and the object + remote conditions.

3. There will be a significant difference in the global field power (GFP) peak amplitudes between the face and the object conditions.

4. There will be a significant correlation between the SCS and paranoia questionnaire factors, and the subtracted difference between the peak GFP values of the face and face + remote conditions, and the object and object + remote conditions.[4]

5. There will be a significant correlation between the SCS and paranoia questionnaire factors, and the subtracted difference between the average skin conductance values of the face and face + remote conditions, and the object and object + remote conditions.

Although the first experiment suggested that the addition of a remote stare stimulus may reduce peak GFP activity of face processing, previous parapsychological studies have demonstrated changing directions of effect, and therefore the hypotheses remained two-tailed. Depending upon the nature of any potential effect, several *post-hoc* analyses were planned at this stage in order to further understand the nature of the effects. This included frequency analysis (FFT), event-related band-amplitude (ERBA), partial least squares (PLS) analysis, and analysis of electrode activity for the areas of the temporal lobes associated with face processing.

[4]This is a difficult comparison, but the best index of successful discrimination of the remote staring stimulus is to subtract the peak GFP values between these two conditions. A similar process was used to examine the effect on skin conductance.

7.2.4 Procedure

The procedure of the experiment was virtually identical to the procedure of the first experiment (see section 6.2.4 on page 117). The main difference was that participants were told that they would either see a face or an object at regular intervals, as per the experimental stimuli, rather than just a face as in the first experiment. At the end of the experiment the participants were told that the experiment was attempting to examine the potential brain activity associated with the processing of face and object stimuli, and how the addition of a remote stare might impact upon this activity. This was subtly different from the feedback following the first experiment.

7.3 Results

The data from the experiment was analysed using the Edit package of NeuroScan's Scan 4.3.1 EEG processing suite, SPSS 12 (12.0.0), MATLAB 7, with the Partial Least Squares (PLS) Toolbox, and the R environment (Version 1.9.0) for data manipulation, calculation and graphical display. Perl and Tck/TL scripts were used to extract the data, and examples of these can be seen in Appendix B on page 254.

7.3.1 System Latency Test

Testing the latency of the system, i.e., the average time it takes the system to present the information to the relevant monitors, is essential for experiments that rely upon millisecond timing accuracy, as is the case in event-related potential (ERP) measures. Due to minor program and hardware changes, it was assumed that the system test prior to the first experiment (see section 6.4.1 on page 121) would be an adequate measure of the system latency for all subsequent experiments. However, a preliminary check on the validity of the data acquired at half-way through the experiment (at the tenth participant) revealed significant temporal discrepancies between the ERP components of the different stimulus conditions. Therefore is was necessary to conduct a more extensive system test, which differed from the system test conducted prior to experiment one as it involved testing the presentation of each of the experimental stimuli.

Similar to the original system latency test, a photoelectric diode was attached to the centre of the staree's computer monitor, and the output was fed through the test channel of the EEG amplifier. The experiment was then run in order to determine the output of the diode to the change in screen when the images relating to the four different experimental conditions were presented. This then provided an accurate measurement of the onset of the presentation of the stimuli, and therefore the system latency for each condition.

7.3.1.1 Results of the latency test

The results of the initial system latency for all four conditions are shown in figure 7.1. As can be seen, there is considerable variability in the onset times of the different stimuli, with the onset of the voltage deflection for the two object conditions being in the prestimulus period, and the onset of the two face conditions being over 100 milliseconds after the desired onset time of zero. Close inspection of the program that runs the experiment revealed a tiny, but significant, difference in the ordering of the operational instructions for the two face and the two object conditions. Once this difference was corrected, the system latency test was conducted again.

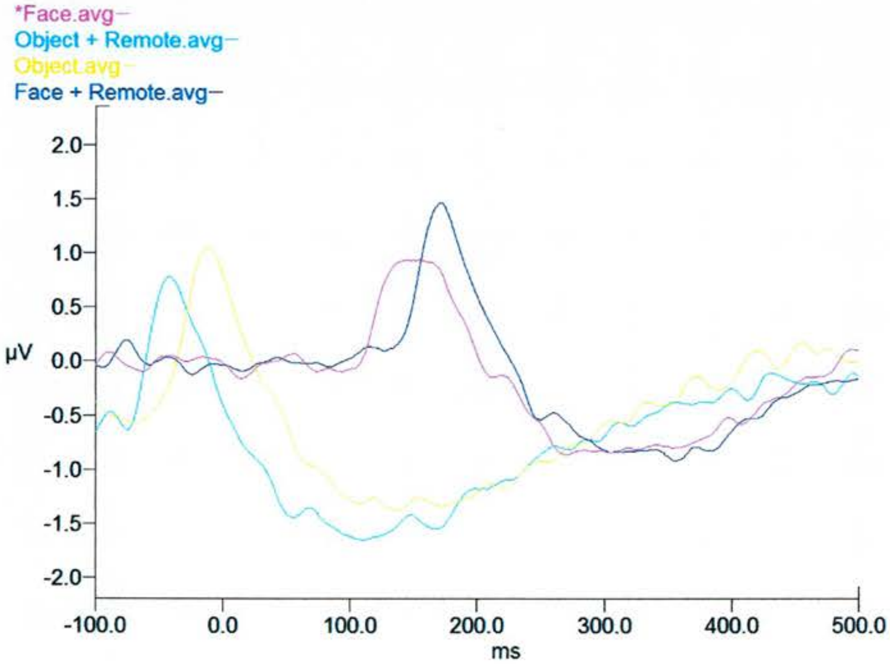

Figure 7.1: Graph showing the initial system latency results for all four conditions

The results of the second system latency test is shown in figure 7.2, which demonstrates that the program correction was successful. As can be seen, all of the conditions now demonstrate the onset of the voltage deflection, and therefore the system latency, as being at 94 milliseconds. This means that the triggers of all of the conditions could be corrected for the 94ms system latency, and the temporal information of any potential ERP components can be correctly identified. This also means that any comparisons between ERP components of the different conditions are equivalent, and not subject to a variable latency.

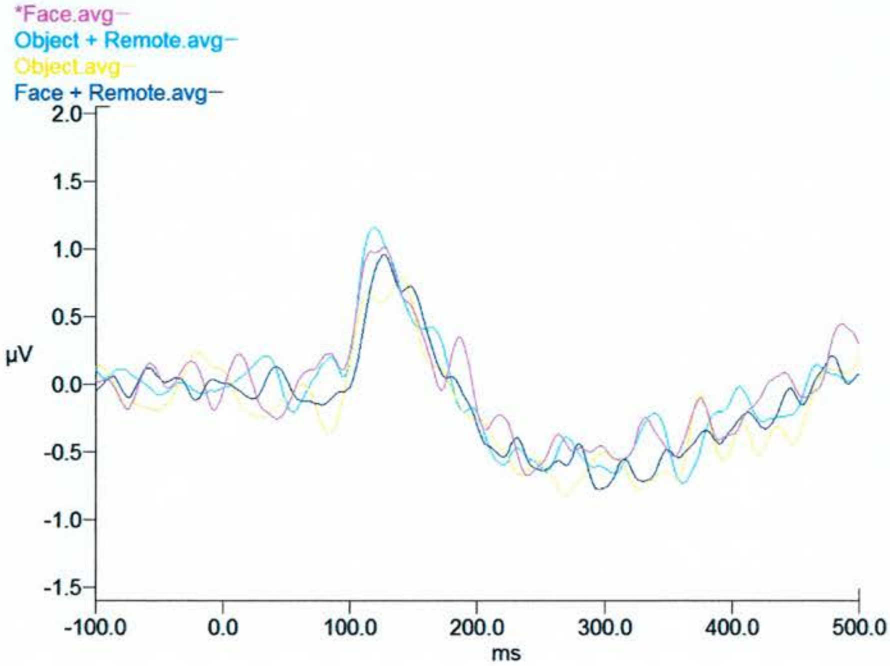

Figure 7.2: Graph showing the revised system latency results for all four conditions

The data from 10 participants had already been collected by the time of the system test, and extensive adjustments were attempted using the information gathered from the unadjusted system test demonstrated in figure 7.1. However, locating an accurate onset time for each stimulus condition proved to be difficult, and there was the possibility that inaccurate temporal adjustments to participant data could introduce false ERP components into the data. As a consequence, the data from these 10 participants was treated as an extensive pilot study to understand the nature of the system and not included in the final analysis. Additional participants were recruited to replace the lost data sets.

7.3.2 Data Preparation for ERP analysis

Prior to the analysis, the EEG data was pre-processed in order to remove artefacts. Initially a linear derivation was conducted in order to convert the monopolar ocular channels into bipolar channels. The data then had ocular artefacts removed using the bipolar vertical electrooculargram channel, with 30 sweeps at 400ms derivation, with a positive trigger at 10% threshold. The data was then visually inspected, and bandpass filtered with a high filter of 1Hz with a 24dB/oct rolloff, and a low filter of 30Hz with a 24dB/oct rolloff. The data was then epoched into all four conditions[5], with an epoch length of −100ms to +800ms. This epoch length was longer than the original study (which was from −100ms to +500ms) in order to provide more information on the progression of the effects over a longer period of time. This increased epoch length, combined with the tougher minimum threshold of artefact rejection (outlined below), meant that a greater number of administrations of each condition were needed in this experiment compared to the original experiment (60 administrations compared to 48 in the original study, see section 6.2.2.1 on page 112) as the increased epoch duration and higher rejection criteria can potentially result in more individual epochs being rejected. A baseline correction was performed to baseline to the pre-stimulus period.

Artefact rejection was then conducted using a minimum threshold of $-75\mu V$ to $+75\mu V$ (this was more stringent than the artefact rejection from the original study, which was using a threshold from $-100\mu V$ to $+100\mu V$), followed by a visual inspection of the data. The data was then averaged according to the different conditions. It was only at this final stage that the data was treated in the separate conditions; all conditions were treated simultaneously prior to this in order to have blind treatment of the data.

7.3.3 Hypothesis testing

7.3.3.1 Event-related potentials analysis

As per experiment one, the main measure of this experiment was the conservative Global Field Power (GFP) measure. Due to slight variations in the type of conditions used from the first study, and because of small latency variations between the two sample populations, it would not have been valid to use the peak latencies identified from experiment one as the peaks or 'Regions of Interest' (ROIs) for experiment two. Therefore, it was necessary to explore the data for relevant peaks in a similar way to the analysis method of the first experiment. This involves collapsing the Grand Average GFPs of all of the participants, and all of the stimuli, into the same waveform, producing the more conservative and

[5]All of the conditions were subjected to artefact rejection simultaneously in order to prevent particular conditions from being treated differently than others, which could artificially impact any potential effects.

temporally accurate data for peak detection analysis. The combined GFP can be seen in figure 7.3. There are two discrete components represented, one at 150ms, and a second at 208ms. These peaks are analogous to the components at 134ms and 228ms from the first experiment, with differences due to the different sample populations.

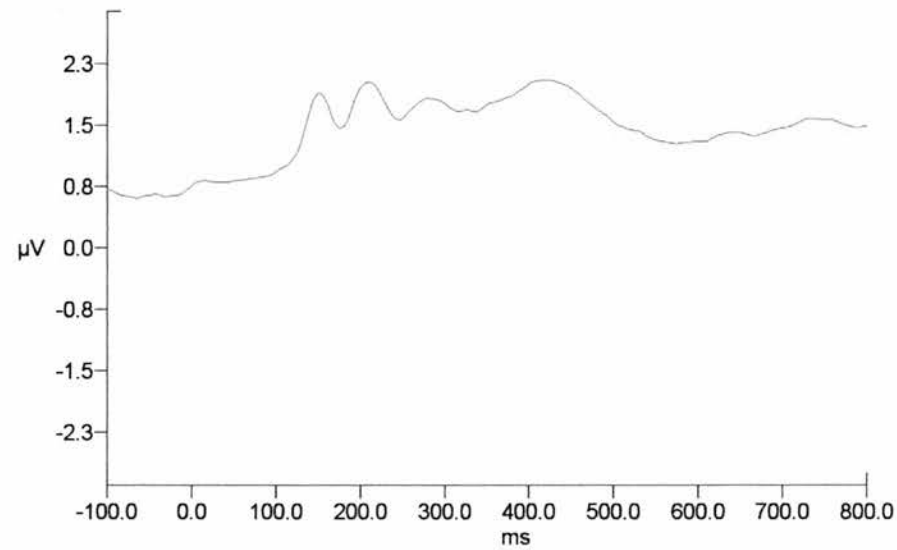

Figure 7.3: Overall GFP of all participants and all conditions

The results from the GFP of each of the individual conditions shown in figure 7.4 demonstrates the temporal relationship of the global field power for the four different conditions at the peaks 150ms and 208ms. The means and standard deviations for the different conditions for these two peaks is shown in table 7.2. Although the GFP measure ignores the direction of the effect (all data points are positive), the 150ms peak represents the initial P1 component, and the 208ms peak represents the N1 component, both associated with object and face processing, although this is on a global level. Shapiro-Wilk analyses of the data did not demonstrate any significant non-normal distributions for any of the GFP data, and therefore parametric statistical tests were conducted on this data.

Separate 2 $\times$ 2 (image type $\times$ remote staring manipulation) repeated measures ANOVAs were run on each of the two peaks of interest.[6] The initial P1 component (150ms) shows a significant effect for remote staring processing ($F_{(1,19)} = 6.952$, $p = .016$), but not for the difference between face and object

[6]Modified alpha for this analysis was calculated as: $\alpha_{MB} = .025$. As was noted in section 6.4.4.1 on page 130, Mauchly's W Test of Sphericity is only applicable for repeated measures ANOVAs with degrees of freedom greater than one, and is therefore does not apply to 2 $\times$ 2 factor ANOVAs.

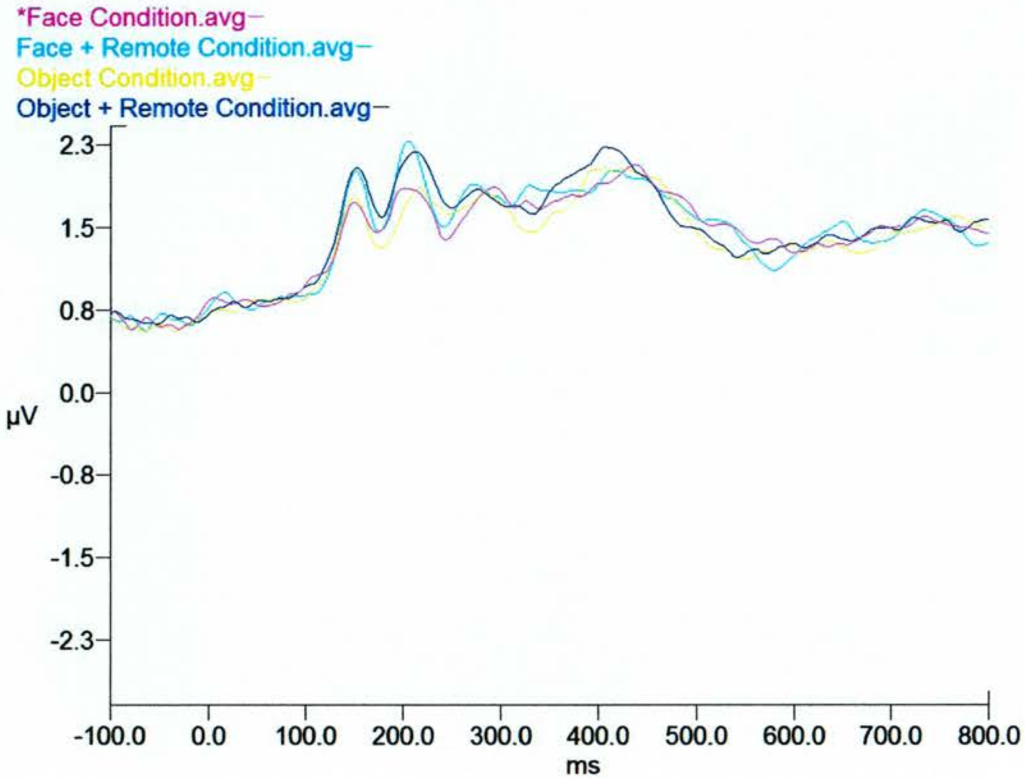

Figure 7.4: GFP of all participants and all four separate conditions

Condition	*150ms*		*208ms*	
	Mean	SD	Mean	SD
Face	1.72	.68	1.85	.75
Face + Remote Stare	1.99	.74	2.25	.94
Object	1.76	.65	1.79	.61
Object + Remote Stare	2.02	.73	2.17	.80

Table 7.2: Means (in µV) and standard deviations of the GFP values for the two peaks of interest for the four experimental conditions.

processing ($F_{(1,19)} = .177$, $p = .679$) and no interaction effects ($F_{(1,19)} = .002$, $p = .968$). The second component, N1 (208ms), mirrors these findings, with a significant effect for the processing of a remote stare ($F_{(1,19)} = 23.229$, $p < .001$), and no significant difference between the processing of faces and objects, ($F_{(1,19)} = .450$, $p = .511$), and no interaction effect ($F_{(1,19)} = .018$, $p = .896$).

7.3.3.2 Skin conductance analysis

The data from each participant for their entire session recording was normalised using a z-transform, of which the equation is as follows:

$$z_i = \frac{x_i - \bar{x}}{\sigma} \tag{7.1}$$

Where z_i = the transformed i^{th} datapoint, x_i = i^{th} raw datapoint, $\bar{x}$ = mean of the entire dataset, and σ = the standard deviation of the entire dataset. This normalisation is necessary as it prevents one individual participant with extreme data driving a potential effect.

The data from each individual stimulus administration (for the full five seconds that the stimuli were present) was then averaged by condition to provide a mean, standardised value of the skin conductance value for each condition. The mean skin conductance values (and standard deviations) for the 20 participants used in the EEG analyses is shown in figure 7.5. Because of the nature of the system latency artefact, it only affected the EEG data and therefore a second analysis was conducted on all of the valid skin conductance data collected over the course of the experiment.[7] The mean skin conductance values (and standard deviations) for all of the 32 participants tested can be seen in figure 7.6.

The data from both samples of participants was found to significantly violate the assumptions for a normal distribution, as demonstrated by the significance values of the Shapiro-Wilk tests summarised in table 7.3. As a consequence of this, all tests employing the skin conductance data were non-parametric.

The analysis of the mean skin conductance of the 20 participants used in the main analysis suggested that there were no significant differences between the face condition and the face and remote stare condition (Wilcoxon Signed Ranks, $T = -.579$, $p = .563$, $Cohen's\ d = .260$)[8], and that there were no

[7] Noise artefacts that affected the EEG data also affected the skin conductance data from two participants from this additional sample and had to be removed from this analysis. Therefore this additional sample is comprises a total of 32 participants.

[8] Cohen's d is calculated using the following formula (Becker, 1999): $Cohen's\ d = \frac{M_1 - M_2}{\sigma_{pooled}}$,

Condition	20 participants		32 participants	
	Shapiro-Wilk[a]	p-value	Shapiro-Wilk[b]	p-value
Face	.845	.004	.906	.009
Face + Remote Stare	.752	¡.001	.840	¡.001
Object	.869	.011	.888	.003
Object + Remote Stare	.648	¡.001	.719	¡.001

[a] $df = 20$
[b] $df = 32$

Table 7.3: Shapiro-Wilk test for normality results for the mean skin conductance values for each condition for the two samples of participants

significant difference between the object condition and the object and remote stare condition ($T = -1.848$, $p = .065$, *Cohen's* $d = .233$). Additionally, there were also no significant differences between the face condition and the object condition ($T = -.597$, $p = .550$, *Cohen's* $d = .117$).

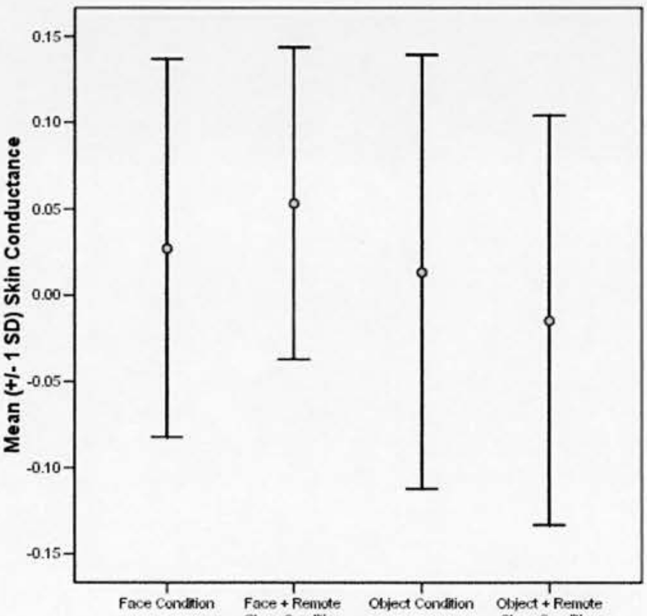

Figure 7.5: Mean normalised skin conductance activity (with $\pm$ 1 standard deviation) for all four conditions for the participants in the main analysis.

The analysis of the mean skin conductance of all of the participants also suggested that there were no significant differences between the face and the face and remote stare conditions ($T = -.234$, $p = .815$, *Cohen's* $d = .228$),

where $\sigma_{pooled} = \sqrt{[\frac{\sigma_1^2+\sigma_2^2}{2}]}$.

and that there were no significant differences between the object and the object and remote stare conditions either ($T = -1.187$, $p = .235$, $Cohen's\ d = .226$). Finally, no significant differences were found between the face condition and the object condition ($T = -.168$, $p = .866$, $Cohen's\ d = .043$).

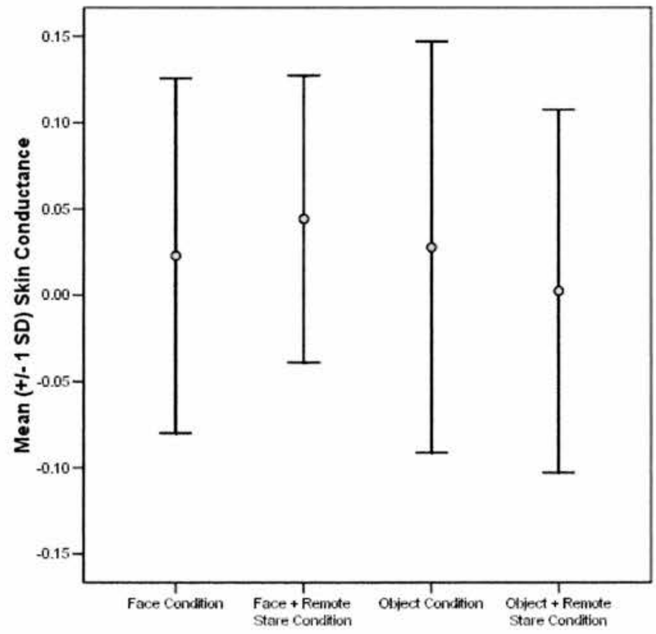

Figure 7.6: Mean normalised skin conductance activity (with ± 1 standard deviation) for all four conditions for all of the participants tested.

7.3.3.3 Questionnaire analysis

The data from the self-consciousness (SCS) questionnaire and the paranoia questionnaire were compared to the skin conductance and to the global field power data. In order to examine the potential relationship between the five factors of the SCS (as identified by Mittal & Balasubramanian, 1987) and the data from the paranoia questionnaire with the effect of remote staring upon the psychophysiological factors, the data from the 'normal' conditions (i.e., the face condition, or the object condition) was subtracted from the respective 'remote' conditions (i.e., the face and remote stare condition, or the object and remote stare condition). Theoretically, this subtracted value should remove the effect of the processing of the conventional stimulus and provide an index of the effect of the remote stare alone. The questionnaire data from all 20 participants was compared to the skin conductance and GFP data using

Spearman's Rho correlations. There were no significant correlations between any of the questionnaire factors and the psychophysiological data.

7.3.3.4 Summary of the hypothesis testing

The results from the hypothesis testing suggest that there is a significant difference between the peak GFP amplitudes for the face and the face + remote stare conditions for both the 150ms and 208ms peaks, and between the object and the object + remote stare conditions for the 208ms peak. In contrast, there was no difference in the global processing between faces and objects, presumably because of the highly specific processing differences between faces and objects.

The analysis of the skin conductance data did not find any significant differences between the face and the face + remote stare conditions, or between the object and the object + remote stare conditions, for either just the participants included in the main ERP/GFP analysis, or all of the participants with valid skin conductance data.

The analysis of the questionnaire data and the subtracted GFP remote staring values did not suggest any significant correlations between elements of the SCS and paranoia questionnaire and with either the GFP measures, or with the skin conductance measures.

7.3.4 *Post-hoc* analyses

In order to explore the nature of the remote staring effect, and the difference between face and object processing further, it was necessary to conduct a series of *post-hoc* analyses. The first set of analyses were examining the effect of remote staring and the difference between face and object processing at the P8/T6 electrode set, which has been identified as one of the primary areas associated with face processing (see Chapter 5). The set of second analyses examined the effects of the earliest administrations of the stimuli on the skin conductance measure, in case there were habituation effects on the full dataset. The third analysis focussed on examining the processing of the different stimuli over the full five seconds that starees were exposed to them, as opposed to the initial 800ms of processing that was analysed above. The fourth set of analyses were exploratory and attempted to deconstruct the nature of the event-related processing of the stimuli into different frequency bands for evoked and induced activity using Event Related Band Power (ERBP). Finally, an analysis is reported where the effects of the different stimuli on ERP activity from all of the electrodes is modelled using

Partial Least Squares (PLS) analysis in order to provide a greater understanding of the nature of the effects in this experiment.

7.3.4.1 Further ERP analysis

As significant effects were found on a global level, it is possible to conduct *post-hoc* analyses on specific cortical areas of interest. As suggested previously in section 6.5 on page 137, one of the limitations of the first experiment was that it was not possible to compare the face-only condition to anything other than a blank-screen, in order to verify the validity of the face processing effect in itself. With the introduction of the object condition in this experiment, it is possible to examine whether or not face processing in itself was occurring. This would provide evidence that the experiment is working appropriately as measured by a more conventional paradigm, and possibly further information on the nature of the effects of remote staring detection.

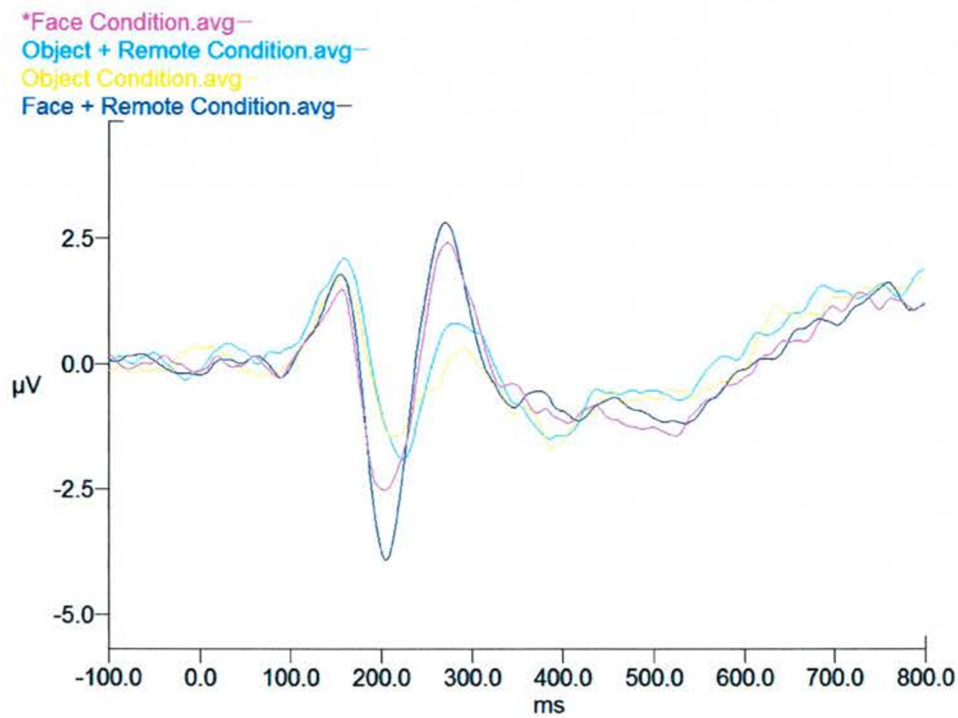

Figure 7.7: P8/T6 electrode ERP activity for all four conditions

Post-hoc analyses of the activity at the P8 (T6) electrode were conducted, as this site is the closest location to where one of the primary face processing areas of the brain is broadly located (Eimer, 2000; Itier & Taylor, 2004). When the P8 electrode, shown in figure 7.7, is compared to its counterpart on the

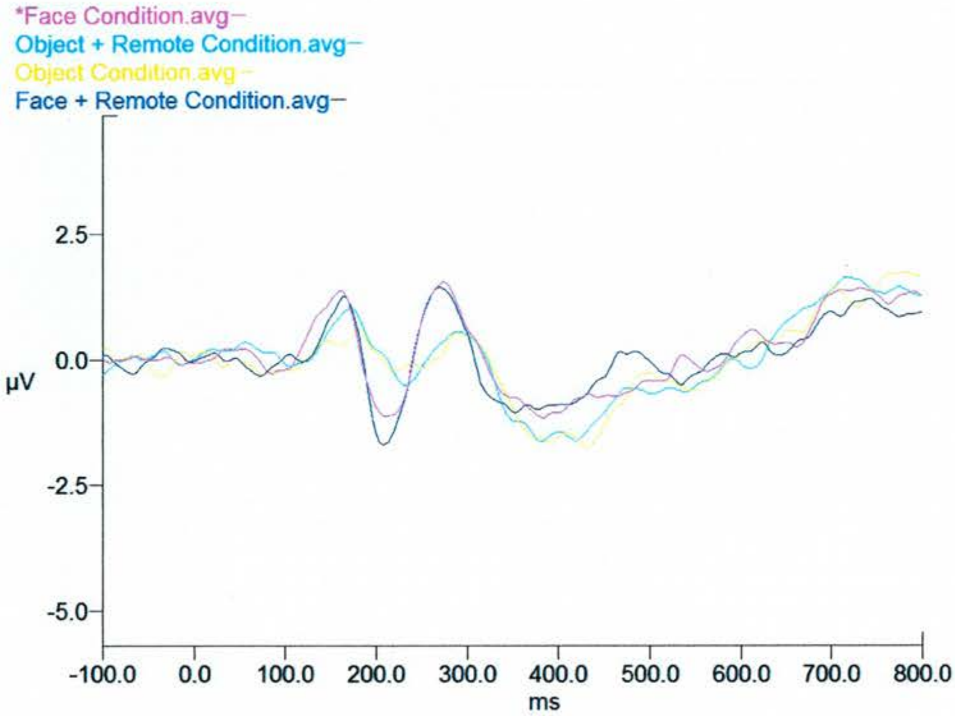

Figure 7.8: P7/T5 electrode ERP activity for all four conditions

left-hemisphere of the brain (i.e., P7/T5 electrode) shown in figure 7.8, it is clear that there is a greater degree of activity occurring (although the same waveform characteristic) for the P8 site compared to the P7 site.

Condition	*150ms*		*208ms*		*272ms*	
	Mean	SD	Mean	SD	Mean	SD
Face	1.36	1.15	-2.46	2.56	2.39	2.14
Face + Remote Stare	1.71	1.75	-3.80	2.75	2.79	2.80
Object	1.63	1.48	-1.41	1.83	-.05	2.01
Object + Remote Stare	1.91	1.30	-1.45	2.24	.73	2.45

Table 7.4: Means (in µV) and standard deviations of the ERP values for the three peaks of interest for the four experimental conditions.

Separate 2 × 2 (image type × remote staring manipulation) repeated measures ANOVAs were run on the peak amplitudes of the three peaks of interest.[9] The means and standard deviations for these three peaks and for the four different conditions is shown in table 7.4. The first component, P1 (150ms), demonstrated no effect of remote staring ($F_{(1,19)} = 1.747$, $p = .202$),

[9]Modified alpha for this analysis was calculated as: $\alpha_{MB} = .016$.

or for differences between face and object processing ($F_{(1,19)} = 1.847$, $p = .190$). However, the negative component, N1 (208ms), shows a significant effect for the processing of a remote stare ($F_{(1,19)} = 10.359$, $p = .005$), and for the difference between processing faces and objects ($F_{(1,19)} = 21.029$, $p < .001$), and a significant interaction between the two factors ($F_{(1,19)} = 8.445$, $p = .005$). The plot of the factors in figure 7.9 clearly illustrates that it is the differences between the face and the face and remote stare conditions that is responsible for driving this interaction effect, with little contribution from the object conditions. A series of paired-sample t-tests confirmed that it is the difference between the two face conditions that is the significant difference ($t_{19} = -4.039$, $p = .001$, *Cohen's* $d = .503$), and not between the two object conditions ($t_{19} = .155$, $p = .878$, *Cohen's* $d = .02$). Finally, different from the overall GFP results, as it is heavily localised and not reflected on a global scale, there is a prominent P2 component (272ms). Analysis of this component did not demonstrate a significant effect of remote staring processing ($F_{(1,19)} = 4.451$, $p = .048$) due to the modified alpha level. However, this component does show a highly significant difference between the face vs. object conditions ($F_{(1,19)} = 25.717$, $p < .001$), which corresponds to the previous literature (Itier & Taylor, 2004). There was not a significant interaction between the two factors ($F_{(1,19)} = .475$, $p = .499$).

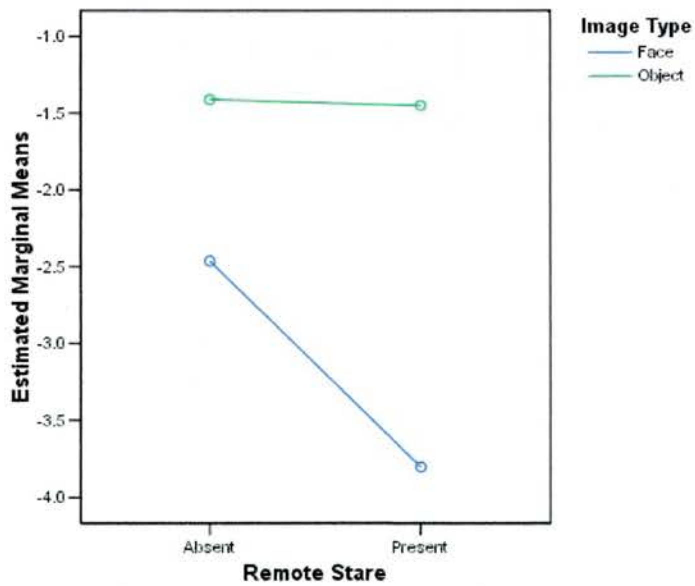

Figure 7.9: Factor interaction plot for the 208ms peak analysis

These results suggest a number of interesting findings. Firstly, that this specialised face processing region of the brain is significantly producing a greater amplitude response when processing faces compared to objects, validating the methodology used in this experiment. However, the findings are potentially more interesting than that alone. The large amplitude difference between the face and the face + remote stare conditions for the N1 component suggests that the remote stare is activating this region even more than faces alone, and that this may be one of the driving force behind this global effect. In addition to this, the relationships of the waveforms between the different types of processing demonstrate a consistency, with the addition of a remote stare not radically altering the nature of the waveform, but instead significantly effecting the peak amplitudes of the waveforms.

7.3.4.2 Further skin conductance analysis

There are two main issues with the skin conductance analysis reported in section 7.3.3.2 on page 152: (a) the difficulty in comparing the data with previous remote staring studies, and (b) the problem of habituation. Firstly, many of the previous remote staring studies employed a very different methodology which focussed on electrodermal activity, as opposed to this experiment that attempted to integrate EEG as well. As a consequence, this study had to use a far higher number of stimulus administrations compared to previous studies in order to obtain valid ERP data. For example, this study used 60 of each stimulus administration, and other remote staring studies have used between 16 (e.g., Schlitz & LaBerge, 1997) and 10 (e.g., Braud et al., 1993a, 1993b; Wiseman et al., 1995) administrations. In addition to this issue, there is clear evidence that electrodermal activity is particularly sensitive to stimulus habituation: Dawson et al. (1990) suggest that skin conductance can habituate (i.e., number of stimulus presentations before two or three trials with no response) from as little as 2 to 8 stimulus administrations. This is an important consideration as the lack of a significant effect in the SC data might not be because there is no effect present, but because the large number of stimulus presentations is causing a strong habituation to the stimuli and eradicating the effect.

In order to investigate this possibility, two *post-hoc* analyses of the skin conductance data were conducted. The first analysis examined the upper-level of the stimulus presentations used in previous remote staring studies, and examined the data from only the first 16 administrations of each stimulus. As Dawson et al. (1990) argue that habituation could take place at far lower levels than even 16 administrations, a second analysis examined only the first 8 administrations of each stimulus. A Shapiro-Wilk analysis suggested that none of the distributions were significantly non-normal, and therefore 2 × 2 repeated measures ANOVAs (image type × remote staring manipulation) were conducted on the data.[10] The valid data from all of the participants in the study (i.e., 32) was included in the analysis in order to provide the strongest power, and the data was normalised as shown in formula 7.1 on page 152.

The means for the different conditions from the 16 stimulus presentation analysis are shown in figure 7.10. There were no significant effects for the remote staring manipulation ($F_{(1,31)} = .442$, $p = .511$), or for the difference between face and object processing ($F_{(1,31)} = 3.459$, $p = .072$), and there were no significant interactions ($F_{(1,31)} = .000$, $p = .983$).

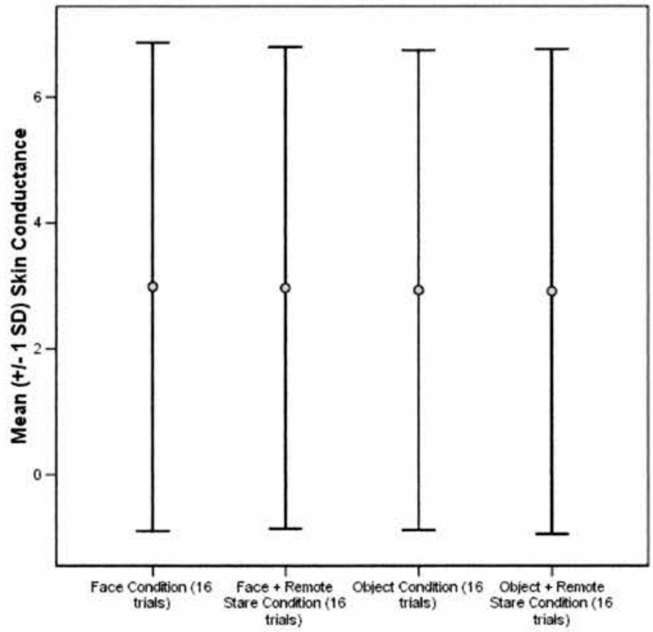

Figure 7.10: Mean normalised skin conductance activity (with ± 1 standard deviation) for all four conditions for the first 16 administrations of each stimulus.

The means for the 8 stimulus presentation analysis are shown in figure 7.11. Similar to the 16 stimulus presentation analysis, there were no significant effects for the remote staring manipulation ($F_{(1,31)} = 1.838$, $p = .185$), or for the difference between face and object processing ($F_{(1,31)} = 4.204$, $p = .049$) due to the Modified Bonferroni correction, and there were also no significant interactions ($F_{(1,31)} = .342$, $p = .563$).

[10]Modified alpha for this analysis was calculated as: $\alpha_{MB} = .025$

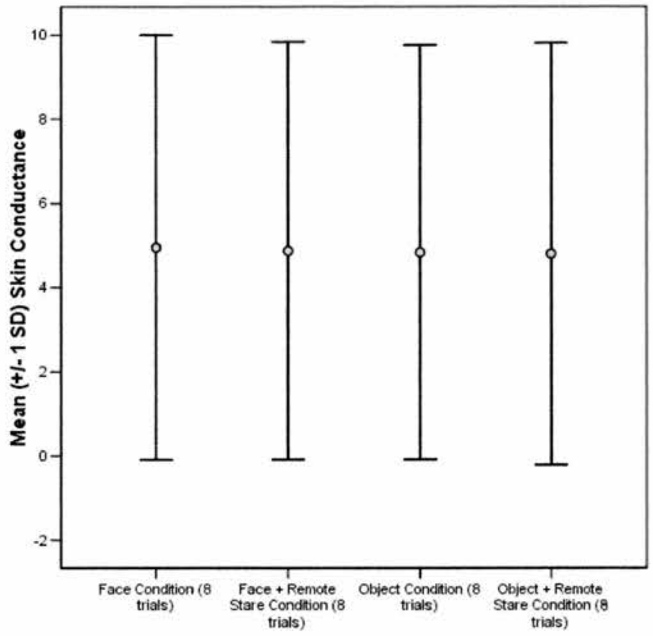

Figure 7.11: Mean normalised skin conductance activity (with ± 1 standard deviation) for all four conditions for the first 8 administrations of each stimulus.

7.3.4.3 Frequency analysis

As with the initial study, although the ERP/GFP results demonstrate a significant result for both the two remote staring conditions, and for the face processing effect, the results are only exploring a small part of the data — only the first 800ms of a 5000ms epoch. However, ERPs are an inappropriate method for examining such a long duration. In the original study, the full 5000ms of data was analysed using fast-fourier transforms (FFTs), also known as frequency analysis, specifically in the alpha band (8–13Hz). As this method produced interesting results that were approaching significance, the same method was applied to the data from the second study. The global alpha band activity for all four conditions over the five second stimulus period (divided into the average activity for each second) can be seen in figure 7.12.

A 4 × 5 factor ANOVA (conditions × time [seconds]) was used to analyse the data, and a Mauchly's W Test for Sphericity was significant (see table 7.5), suggesting that sphericity for the different factors cannot be assumed and that the Greenhouse-Geisser correction needed to be applied to the ANOVA. The ANOVA revealed no significant difference between the α activity of the different conditions ($F_{1.077,20.456} = .821, p = .384$), and no significant effect of time ($F_{1.158,21.999} =$

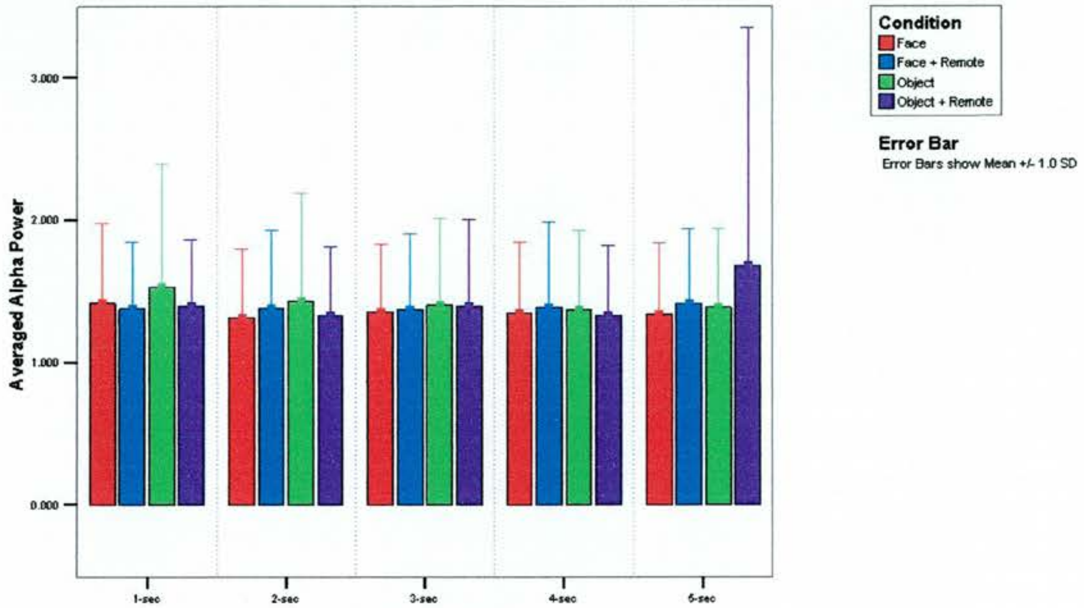

Figure 7.12: Averaged α power for all participants for the four conditions over the 5 second stimulus duration

Within Subjects Effect	Mauchly's W	Approx. χ^2	*df*	*p*	Greenhouse-Geisser ϵ	Huynh-Feldt ϵ
Condition	.003	101.543	5	<.001	.359	.363
Time	.001	124.950	9	<.001	.289	.296
Condition* Time	<.001	709.724	77	<.001	.089	.09

Table 7.5: Mauchly's Test of Sphericity for the alpha FFT analysis of all four conditions

$1.728, p = .204$), and no significant interactions ($F_{1.069,20.304} = .964, p = .344$).

This is an interesting result when compared to the alpha band data from experiment one. The original study suggested that there was a greater (although non-significant) reduction in alpha activity between seconds one and two for the face and remote stare condition compared to the face only condition, but this effect is not present in this data. Because of the absence of this pattern, and because of the reversal of the GFP/ERP effect from experiment one to experiment two, it was necessary to conduct further exploratory analysis of the data, examining the different frequency bands of the evoked and induced components that comprise the processing of the event-related effect.

7.3.4.4 Event-Related Band Amplitude (ERBA) Analysis

The use of event-related potentials can be misleading. As a measure they populate entire bodies of literature in psychology, but as a method they are only investigating a tiny fraction of the data, and do not always reflect the functional information of electrocortical processing of the different stimuli. For example, due to their very nature, ERPs are locked to the onset of the *event* and are therefore regarded as *phase-locked*, or *evoked*. However, there is also other activity that is related to the processing of a particular stimulus that is *non-phase-locked* or *induced*, where the frequency related to the processing of the stimulus is not in phase at the moment of the onset of the event, but is involved in the processing of the stimulus regardless (Kalcher & Pfurtscheller, 1995; Klimesch et al., 2000). Any frequency that is involved in the processing of the stimulus, but that is not phase-locked to that stimulus, is not incorporated into the waveform that comprises the event-related potential. The ERP analysis is not designed to consider it, even though it often represents level of processing that involves a degree of power magnitudes higher than the waveforms from an ERP.

This issue is complicated further by the issue of frequency. The raw EEG and the processed ERPs are intrinsically linked, and if, for example, a change in alpha band power is responsible for the brain to process a particular stimulus, then the resulting ERP will be heavily driven by alpha activity. This type of frequency-related information is often ignored in ERP research. Although it can provide a higher degree of resolution to our understanding of the functionality of an ERP process, the filtering methods used to generate ERPs normally compress the frequency band information into a single, overarching frequency. A typical example would be the filtering used in this experiment for processing the ERP information — the different frequency bands were combined into a single band from 1 to 30Hz (i.e., incorporating Delta wave activity up to High Beta wave activity).

Although the typical ERP data processing methods of combining frequencies and just examining evoked information is excellent at ascertaining significant processing relating to a particular stimulus, it does not provide a more subtle understanding of the driving force behind the ERP. However, it is possible to break-down the processing into the evoked and induced processing for the different frequency bands that comprise the ERP using *Event-Related Band Amplitude* (ERBA). This method neatly deconstructs the processing into its constituent parts for both frequency band and phase.

In order to have a more detailed examination of the nature of the frequency effects on the known evoked activity, and to explore the possible induced activity, ERBA analysis for was used on the following frequency bands for both the evoked and induced components: Delta (δ; 1–3Hz), Theta (θ; 4–8Hz), Alpha (α; 8-13Hz), Low Beta (Lβ; 13–20Hz) and High Beta (Hβ; 20–30Hz). The frequency roll-off was set at 12dB/oct, with a left/right trim of 100ms.[11] In order to obtain an overview of the cortical activity for the different types of phase and frequency bands, global field power was used. The use of GFP measures also allows a direct comparison to the main experimental findings (see section 7.3.3.1 on page 149). As the ERBA analysis was exploratory and focussed on developing hypotheses for testing in future experimental work, no statistics were conducted on the data.

Induced and Evoked Delta Activity: As can be seen from figures 7.13 and 7.14, both the evoked and the induced components of the delta activity demonstrate virtually no differences between conditions. The evoked component contributed very little power to the overall ERP effects, and only a small difference between the face and object conditions from approximately the 350ms point onwards.

Induced and Evoked Theta Activity: As is demonstrated by figures 7.15 and 7.16, the Evoked Theta component neatly contributes and summarises the nature of the overall ERP effect. The overall Evoked Theta (GFP) shows that the remote conditions have a marginally higher processing amplitude than the normal stimuli. In addition to this, when the P8 electrode of the Evoked Theta

[11]The left/right trim is necessary because the ERBA algorithm destabilises at the extremes of the waveform, and trimming prevents false conclusions. This results in an epoch from 0ms to 700ms for the ERBA.

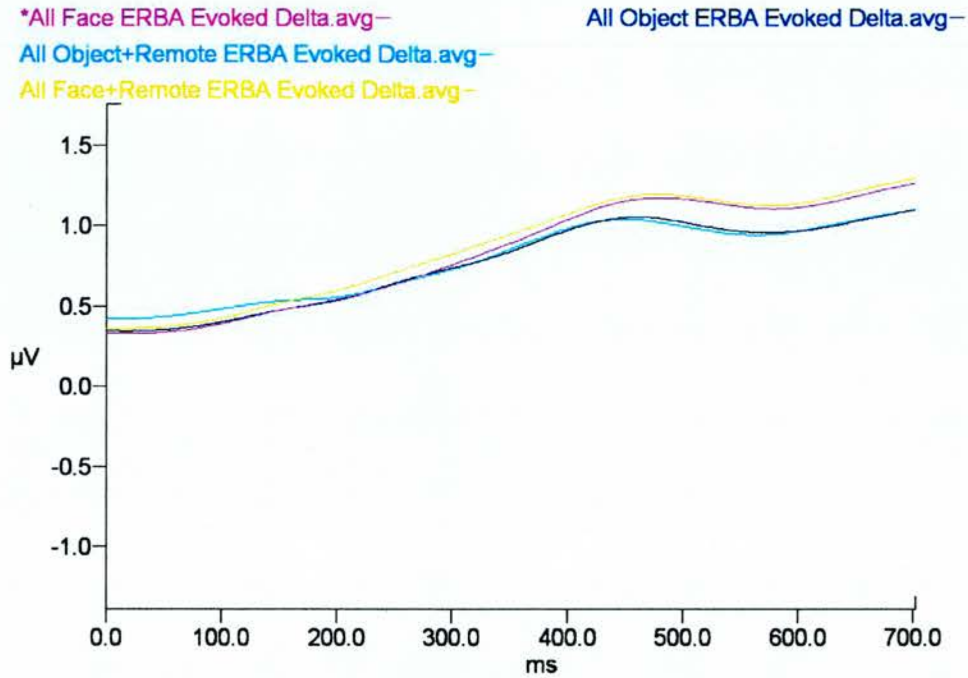

Figure 7.13: GFP of the Evoked Delta Band Activity

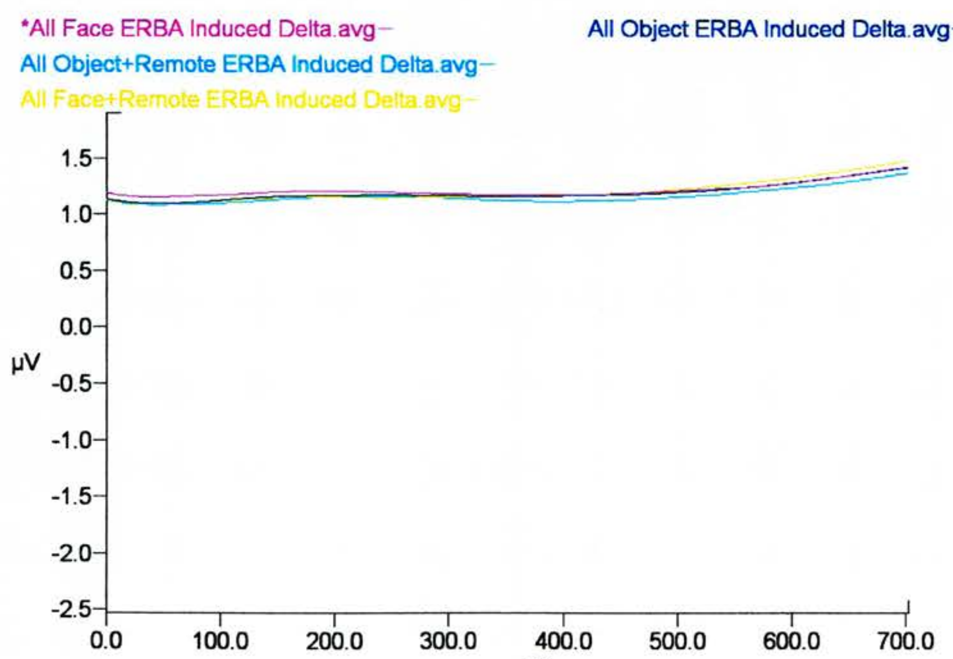

Figure 7.14: GFP of the Induced Delta Band Activity

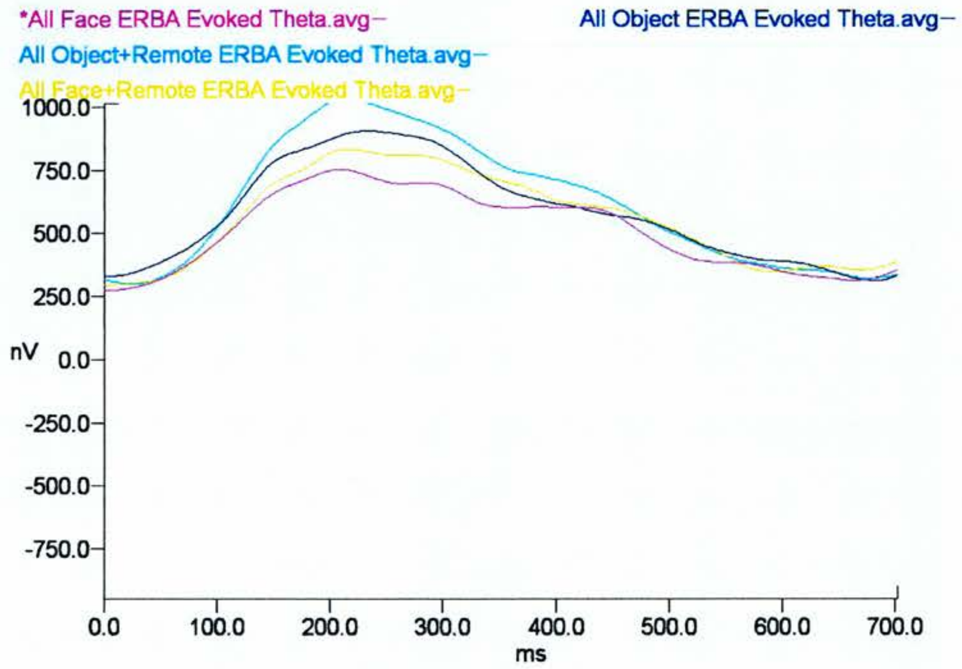

Figure 7.15: GFP of the Evoked Theta Band Activity

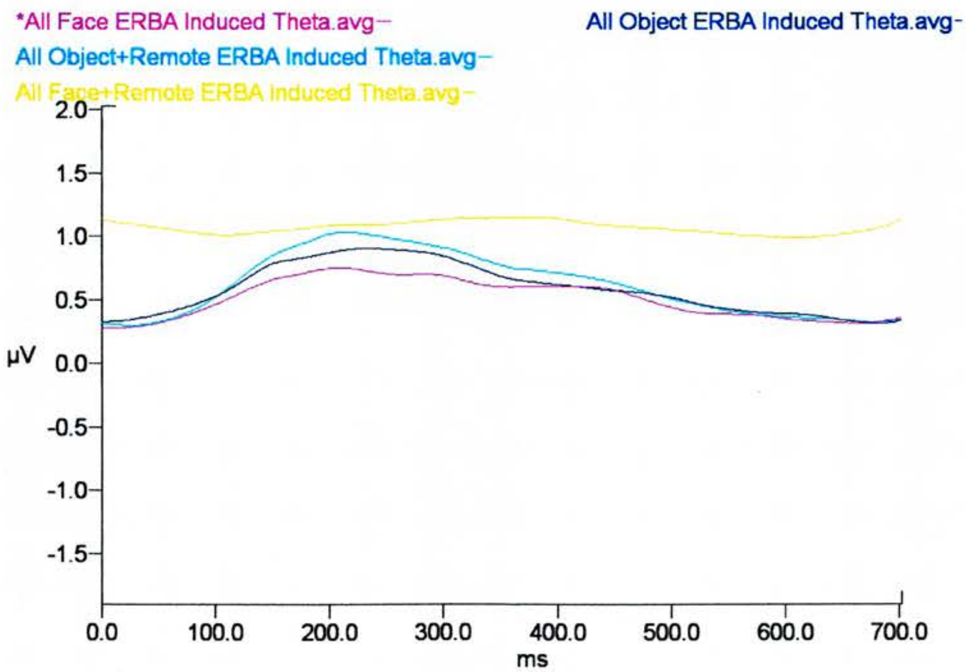

Figure 7.16: GFP of the Induced Theta Band Activity

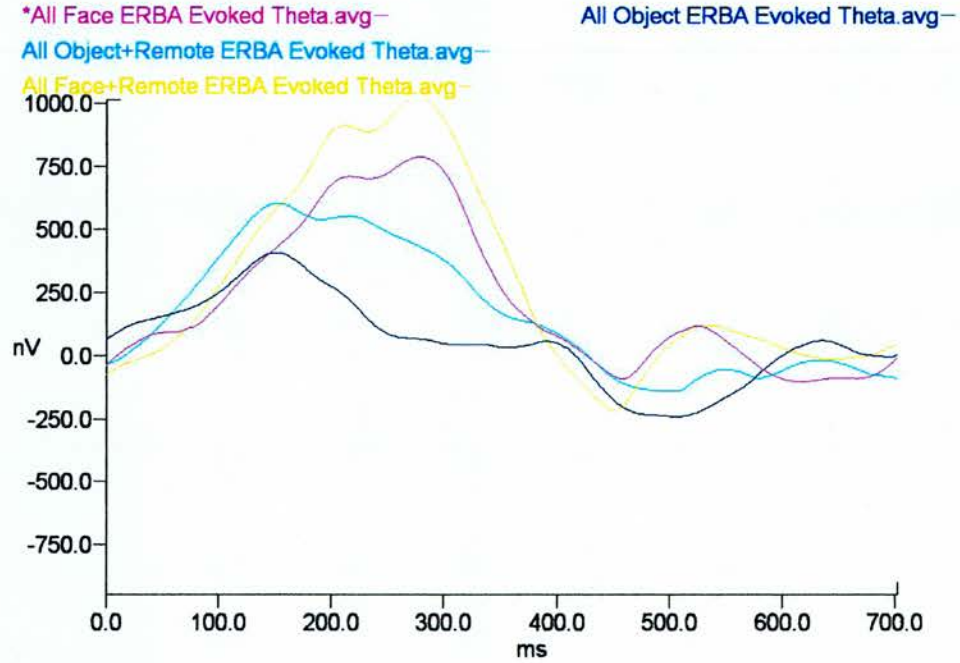

Figure 7.17: P8 Channel Evoked Theta Band Activity

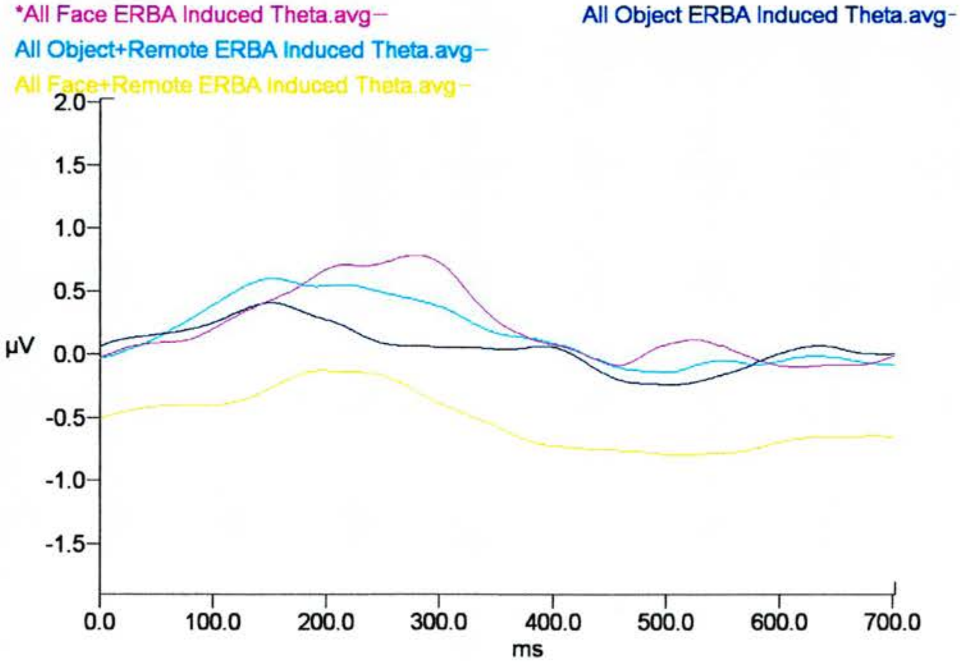

Figure 7.18: P8 Channel Induced Theta Band Activity

component is examined (see figure 7.17), it demonstrates (a) that again, the remote conditions demonstrate a higher amplitude of processing compared to the normal conditions, but also (b) that the nature of the processing of the remote conditions is consistent with the processing of the normal conditions; namely, that faces are processed differently than objects regardless of the addition of a remote stimulus. This data also demonstrates a curious effect for the face + remote condition for the Induced Theta component, as it is considerably higher overall (GFP, see figure 7.16) or lower for the P8 electrode (see figure 7.18) for the entire epoch.This curious effect initially appears to be an artefact when compared to the ERP data. However, the induced component will not be present in ERP data, the analysis program code was identical for this analysis compared to the other ERBA analyses (except for the frequency band changes) and it is present in some of the ERBA analyses and not others. This effect is probably an artefact of the pre-stimulus baseline correction. Using the pre-stimulus period is advisable for ERPs and for evoked components in general because the period before the stimulus onset will not have a great deal of phase-locking between different frequencies. However, the use of this baseline process, although consistent between evoked and induced components, could introduce artefacts because the induced component represents frequencies that are not in phase, regardless of their contribution to the processing of the stimulus. If the induced components were baselined to the entire epoch, rather than the pre-stimulus period, it would indubitably remove this small artefact.

Induced and Evoked Alpha Activity: The Evoked Alpha component appears to contribute to the overall (GFP) remote staring effect noted in the ERPs, as the GFP Evoked Alpha shows peaks for both of the remote conditions (see figure 7.19). The P8 electrode also shows that the Evoked Alpha contributes to the significant face processing effect noted in the ERPs, and confirms that the addition of a remote stare to a face stimulus generates a far higher peak to the face processing component (see figure 7.21). This data also confirms that the Induced Alpha component does not demonstrate anything of significance (see figures 7.20 and 7.22 respectively). However, the lack of induced activity does offer an explanation of why the alpha band frequency analysis did not reveal anything of significance in this experiment. Basically, the FFT analysis is a gross measure of alpha activity and it will incorporate alpha wave activity regardless of its phase. This means that it will incorporated both the evoked and the induced components, and as the non-differentiated induced alpha activity is of a higher

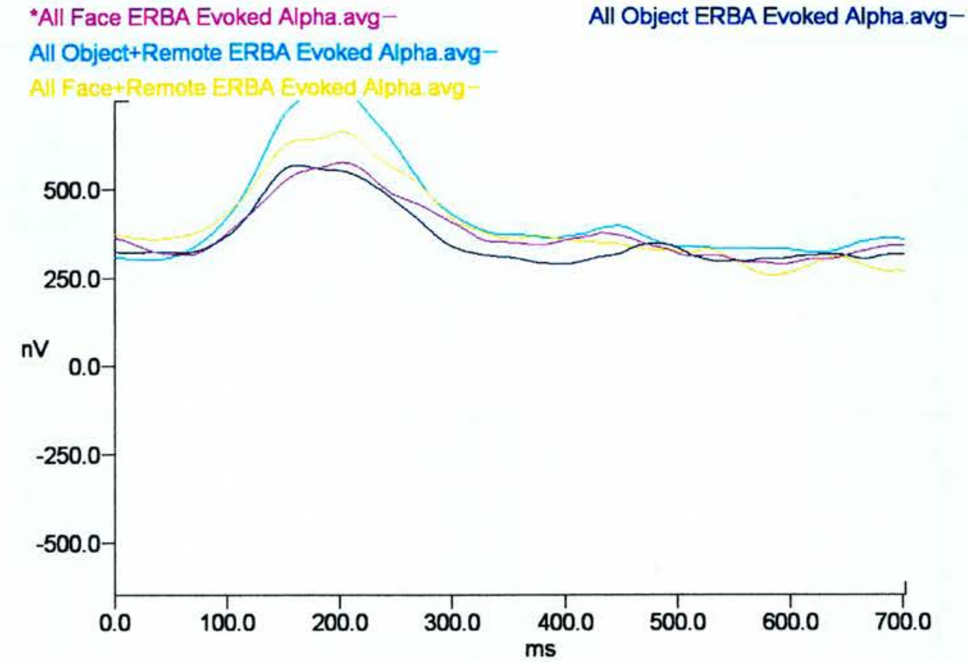

Figure 7.19: GFP of the Evoked Alpha Band Activity

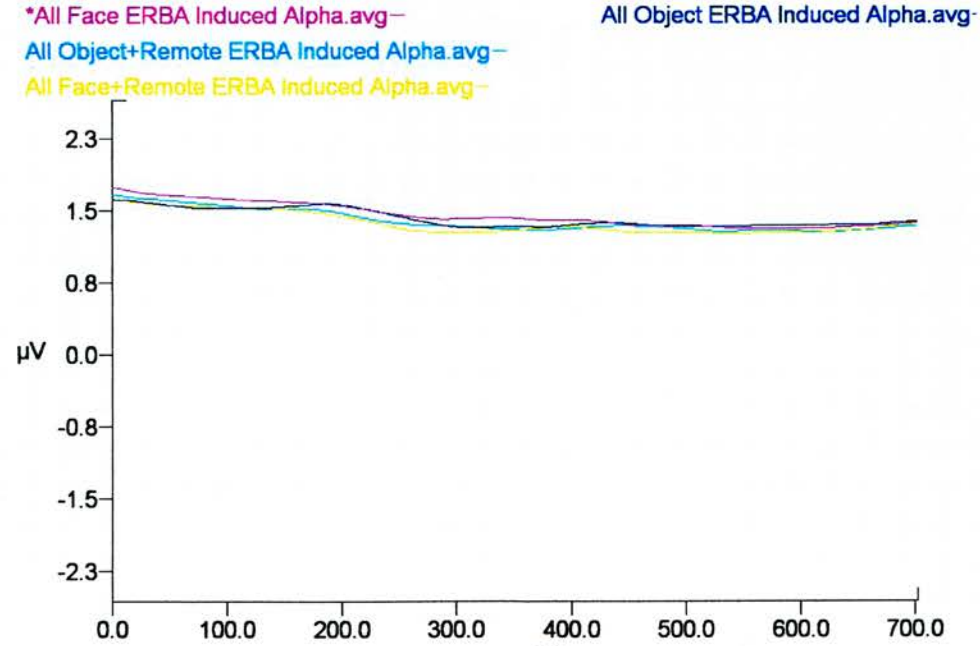

Figure 7.20: GFP of the Induced Alpha Band Activity

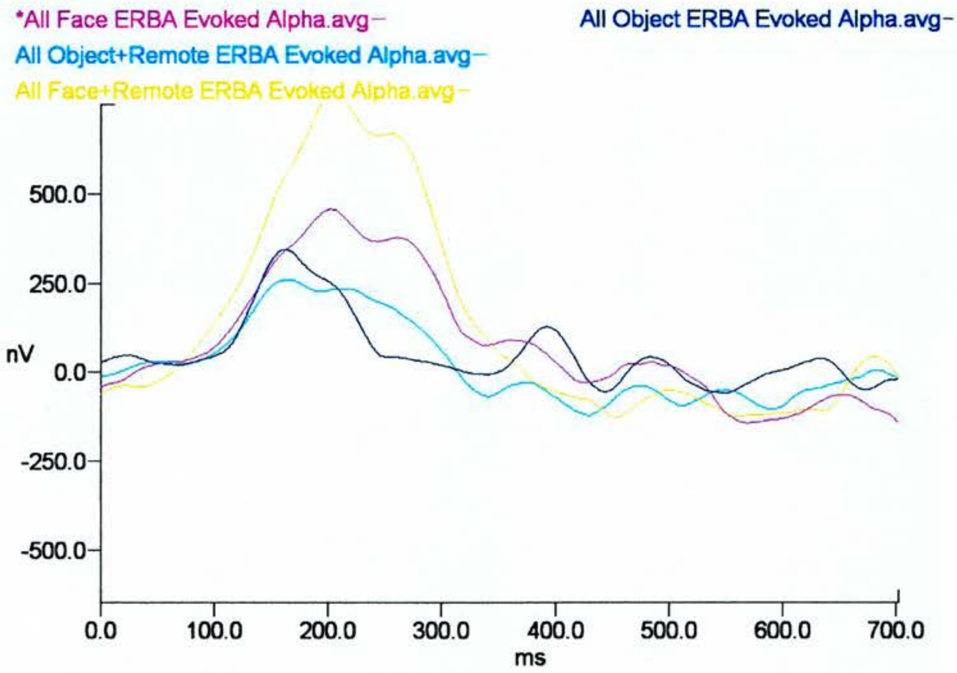

Figure 7.21: P8 Channel Evoked Alpha Band Activity

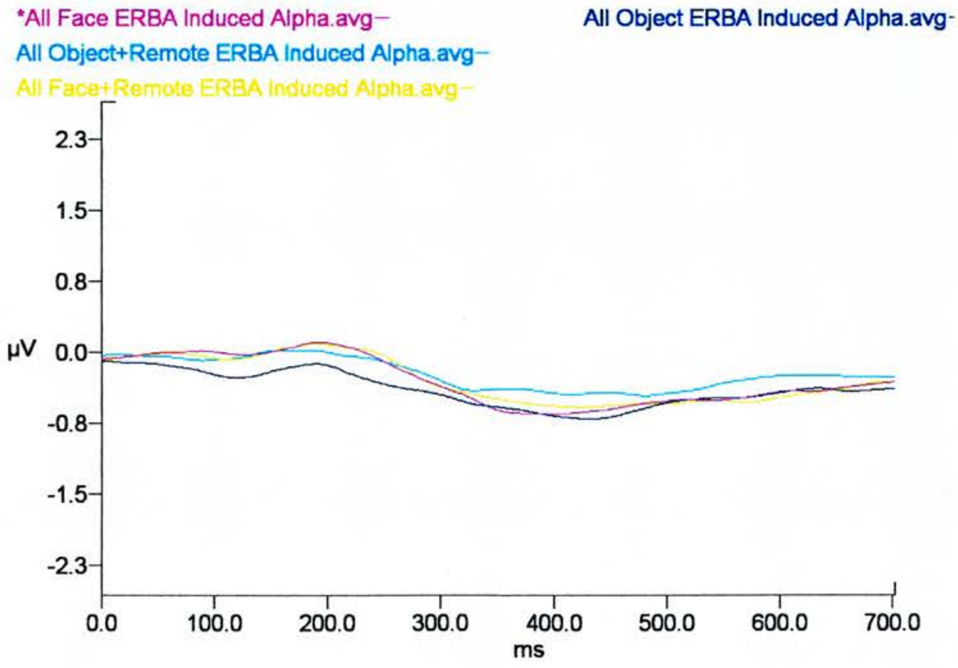

Figure 7.22: P8 Channel Induced Alpha Band Activity

magnitude compared to the induced activity, any subtle alpha shift over time in the evoked component that may have showed up in the FFT is eliminated by the higher powered and unchanging induced activity.

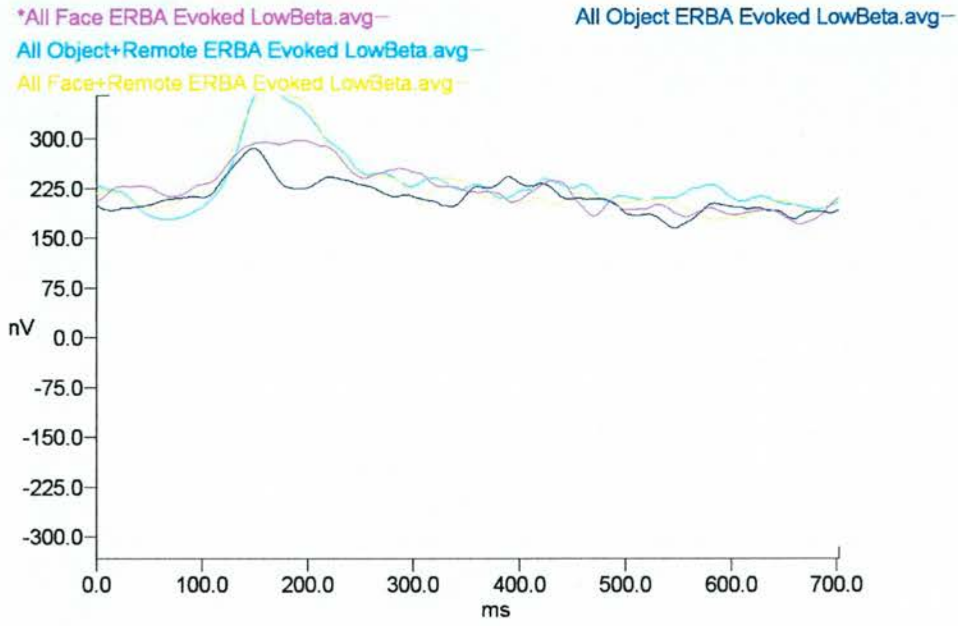

Figure 7.23: GFP of the Evoked Low Beta Band Activity

Induced and Evoked Low Beta Activity: The Evoked Low Beta component appears to contribute to the overall (GFP) remote staring effect noted in the ERPs, as the GFP Evoked Low Beta shows peaks for both of the remote conditions (see figure 7.23). The P8 electrode also shows that the Evoked Low Beta contributes to the significant face + remote processing effect noted in the ERPs, but only appears to have a minimal contribution to the normal face processing effect (see figure 7.25). This data also demonstrates a curious effect for the face + remote condition for the Induced Low Beta component, as it is considerably higher overall (GFP, see figure 7.24) or lower for the P8 electrode (see figure 7.26) for the entire epoch, very similar to the effect noted in the Induced Theta component (see figures 7.16 and 7.18 respectively).

Induced and Evoked High Beta Activity: Both the Evoked (figure 7.27) and Induced (figure 7.28) components of High Beta demonstrate very little difference between conditions. Similar to the delta band (figure 7.13), the evoked component shows only a very small contribution to the overall ERP effects.

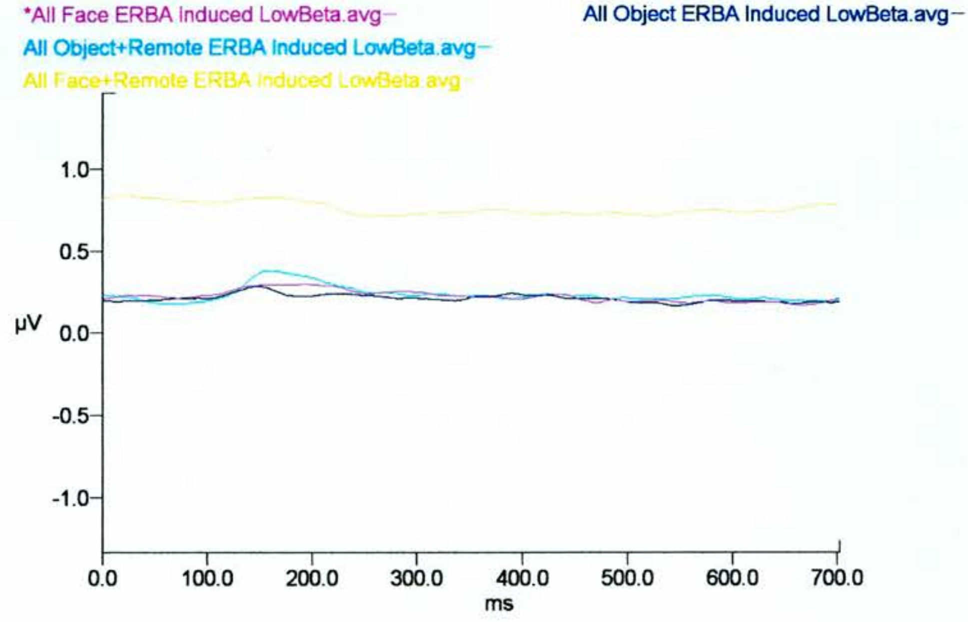

Figure 7.24: GFP of the Induced Low Beta Band Activity

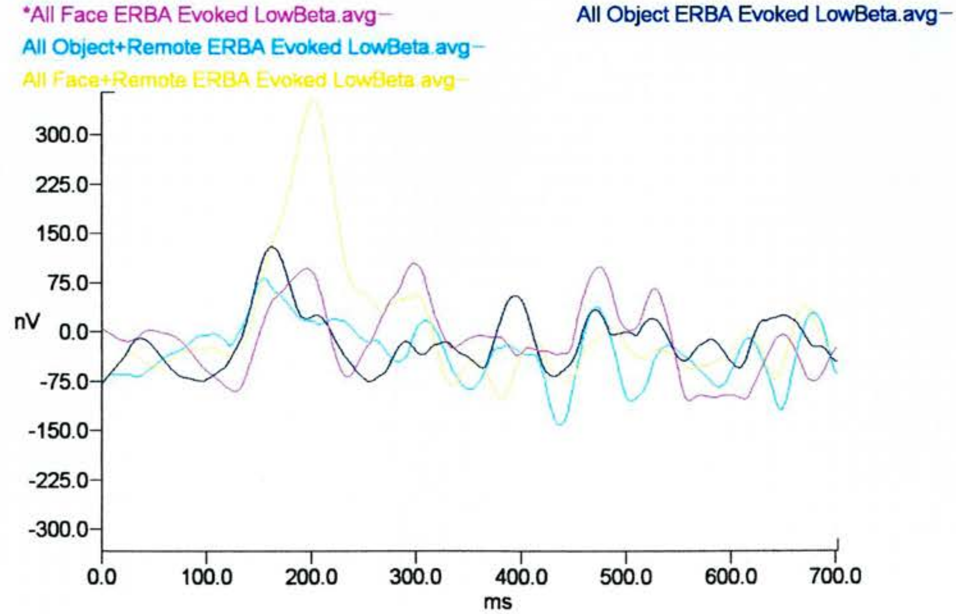

Figure 7.25: P8 Channel Evoked Low Beta Band Activity

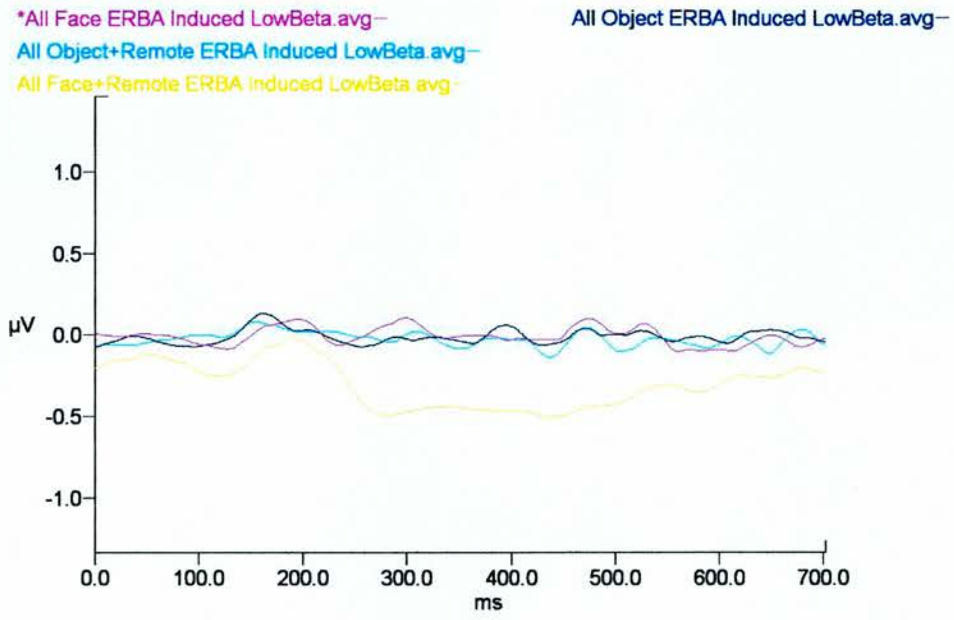

Figure 7.26: P8 Channel Induced Low Beta Band Activity

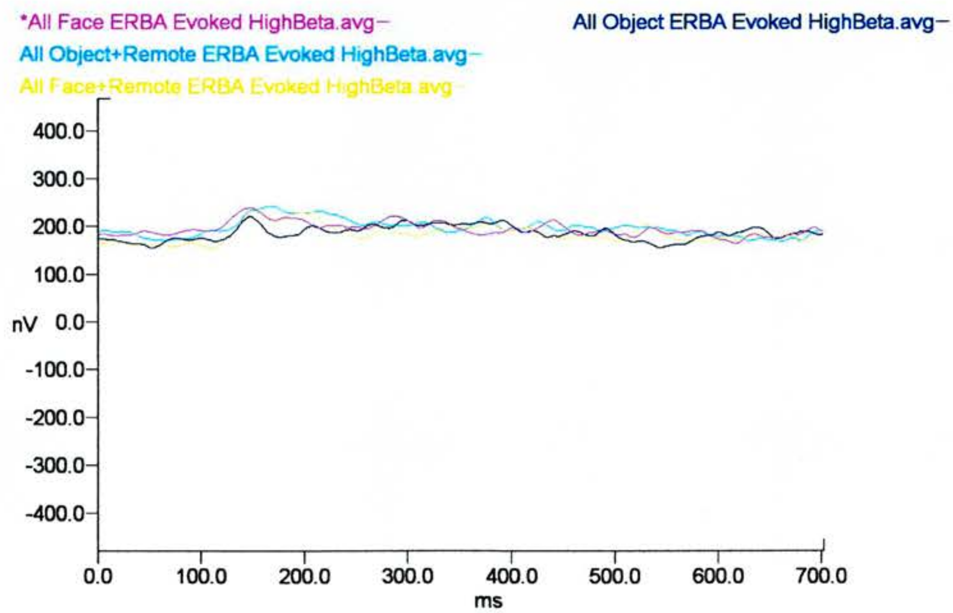

Figure 7.27: GFP of the Evoked High Beta Band Activity

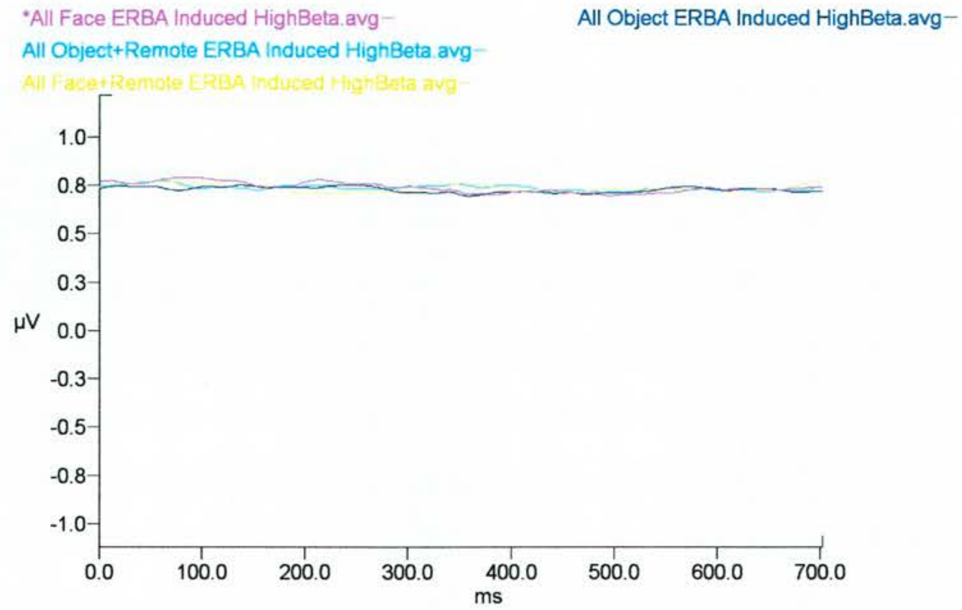

Figure 7.28: GFP of the Induced High Beta Band Activity

Summary of the ERBA analysis: The ERBA analysis is very informative for understanding the potential underlying physiological mechanisms of the remote staring and conventional face processing effects, and will lead to further hypothesis testing. The main activity for the face vs. object processing appears to be within the middle bands of this analysis; namely from Theta to Low Beta (or from 4 to 20Hz), and it appears that the majority of processing is phase-locked (evoked) to the stimulus, with relatively little processing being non-phase-locked (induced). However, the analysis of the individual bands also reveals that the remote staring effects in both the face and object conditions show the same form of processing as their more conventional counterparts (i.e., the nature of the waveforms is almost identical), but the overall peak amplitudes for significant parts of the processing are greater, obviously mirroring the overall ERP/GFP effect. This adds to a greater understanding of the data, as the remote staring effect appears to be heavily dependent upon whatever other processing is going on at the same time, modifying that processing accordingly. It is not changing the overall nature of the waveform, but it is demonstrating higher peaks. This is demonstrated particularly well in both Evoked Theta and Evoked Alpha, where in both bands the overall (GFP) results demonstrate that the peaks in the remote stare conditions are consistently greater than the more conventional conditions. When the P8 face processing area is specifically examined, there are differences in the processing of faces vs. objects (as suggested by the GFP results), and the addition of a remote stare does not change the temporal signature of the face processing, but it does increase the amplitude in both frequency bands. This analysis also reveals that the induced component adds very little to the overall picture of the nature of the remote staring effect, except for the possibility that it is 'diluting' any alpha band differences in the frequency analysis.

7.3.4.5 Modelling the effects: Partial Least Squares Analysis

Partial Least Squares (PLS) analysis is a multivariate and multidimensional method for analysing and modelling experimental effects that has recently been developed to be applied to neuroimaging data, specifically for Positron Emission Topography (PET), Functional Magentic Resonance Imaging (fMRI) and Event-Related Potentials (ERPs) (Lobaugh, West, & McIntosh, 2001; McIntosh & Lobaugh, 2004; Itier, Taylor, & Lobaugh, 2004). Using a MATLAB toolbox, developed primarily by researchers at the Rotman Research Institute[12], it is possible to model the ERP dataset and calculate ROIs that the model estimates are above the 95% confidence interval. This new analysis method can be applied in this case to potentially help verify, model and understand the nature of the effects noted in the main analysis.

As McIntosh and Lobaugh (2004) describe it, "the term 'partial least squares' refers to the computation of the optimal *least-squares* fit to *part* of a correlation or covariance matrix" (p. S250-S251). This method is similar to principal components analysis (PCA), except that the PLS results are constrained to the part of the covariance structure that is due to the experimental manipulations. Once the data is entered into a complex, four-dimensional space matrix of $n * k$ rows (where n is the observations/participants, and k is conditions) by $m * t$ columns (where m is number of elements/electrode channels, and t is the number of time points) it is possible to run permutation and bootstrap analyses. The *permutation test* assesses the identified latent variables of the model by reassigning participants randomly and without replacement to different conditions and recalculating the PLS, which estimates how often the permuted singular values exceed the originally observed values. An *Orthogonal Procrustes* rotation is applied to the result to correct for reflections and rotations of the data. These permutations and probability estimates are typically stable at approximately 100 permutations, but to ensure the stability the results presented here were produced from 500 permutations. The *bootstrap estimation* assesses the reliability of the above analysis, and the participants are resampled with replacement, and again

[12]Toolbox available at http://www.rotman-baycrest.on.ca:8080

the Ortogonal Procrustes rotation is applied. The bootstrap estimates can then be used to calculate the contribution of each datapoint to the latent variable structure, which are normally stable after 100 resamplings (as used here). This calculation of the contribution of each datapoint is then used to essentially plot the regions of interest (ROIs) for each of the latent variables that form the model, for each electrode site. These are shown on the figures as small circles on the PLS waveform plots, which demonstrate a region that is significant at the 95% confidence interval (as according to the PLS model).

The PLS method has been used with considerable success for the analysis of fMRI data (e.g., McIntosh, Bookstein, Haxby, & Grady, 1996), and it is gaining popularity for the analysis of ERP data, mainly because it is a multivariate method of analysis in its own right, but it can also identify ROIs for a more conventional analysis, without the difficulty of peak detection on multiple electrode sites[13] or the potential problems of PCA analysis. This is the first time that PLS analysis has been used in a parapsychological study.

The PLS analysis for Latent Variable 1 (LV1) for all of the conditions can be seen in figure 7.29. Latent Variable 1 is highly significant ($p < .0001$) and explains 64.62% of the covariance. Unsurprisingly, the model is dominated by the face vs. object processing effect, and the more subtle remote staring effect is not easily distinguished by this, mainly because the remote staring effect appears to act upon any other processing that is going on. As it does this and maps onto the same pattern of activity as more conventional processing, it is difficult for the model to consider it differently to the more dominant face vs. object effect, and it incorporates it into the overall model. In figure 7.30 on page 178, the bootstrap analysis of the ROIs for LV1 can be seen, primarily modelling the face vs. object effect. The main differences appear to be central, with some frontal and parietal activity. It is also interesting to note a far greater degree of activity in the right hemisphere for the processing of faces for the important P8/T6 electrode, than compared to the left hemisphere's P7/T5 electrode, which can be seen more clearly in the enlarged figure 7.31, which mirrors the face processing results presented in section 7.3.4.1 on page 156. As has been commented on previously, this effect has also been observed in other studies (e.g., Eimer, 2000; Itier & Taylor, 2004).

The modelling of Latent Variable 2 (LV2) is demonstrated in figure 7.32, and the bootstrap analysis of the ROIs for LV2 can be seen in figure 7.33. LV2

[13]This difficulty is reduced in this study thanks to the use of the averaged GFP measure, the justification of which is outlined in section 7.3.3.1 on page 149.

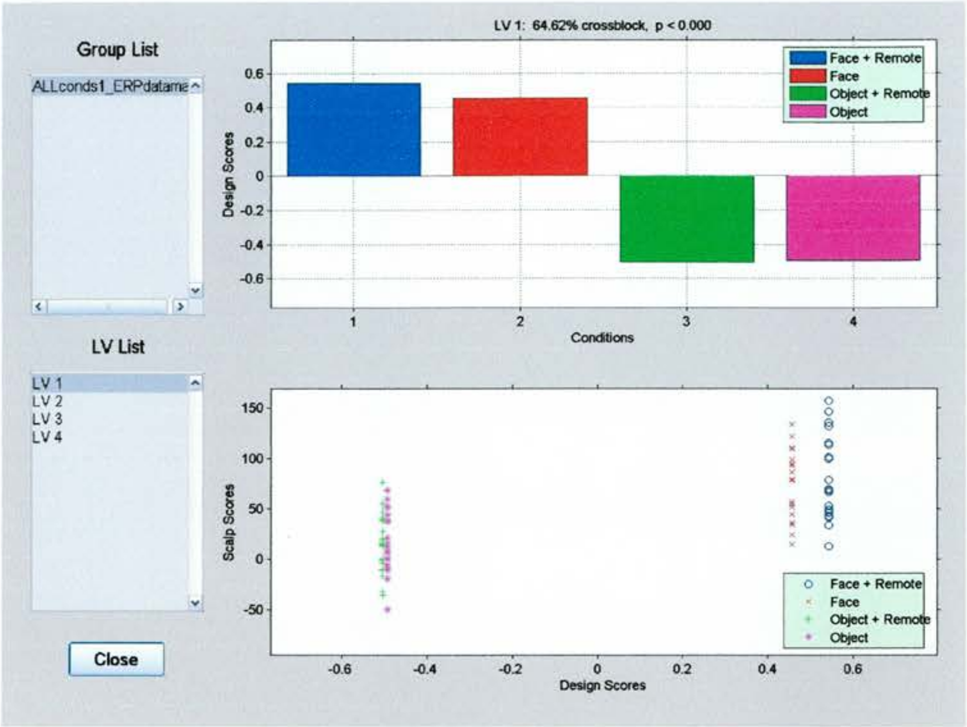

Figure 7.29: PLS model for Latent Variable 1 (LV1)

explains 22.63% of the covariance, but it is not significant ($p < .310$). Its lack of significance is informative in understanding the nature of the remote staring effect and its relationship to more conventional processing. Although it is picking-up on the more subtle remote staring effect, in this case most specifically between the object and object + remote stare conditions, its lack of significance suggests that this Latent Variable represents the non-significant elements of the remote staring effect that do not exactly duplicate the waveforms of the more conventional processing effect.

The PLS analysis confirms that the remote staring conditions are significantly mapping onto the processing of the more conventional stimuli, but the model lacks resolution to significantly discern the more subtle differences in remote staring processing. Because the remote staring processing in both of the face + remote stare and object + remote stare is following the same temporal activity as the conventional analysis, but with a globally higher amplitude at peak latencies, the PLS model can only identify the more gross differences in latency and area processing of the overall face vs. object processing effects, and not the more subtle amplitude enhancement of the remote staring effect. In fact, because the amplitude enhancement of the addition of a remote stare is so conditional to

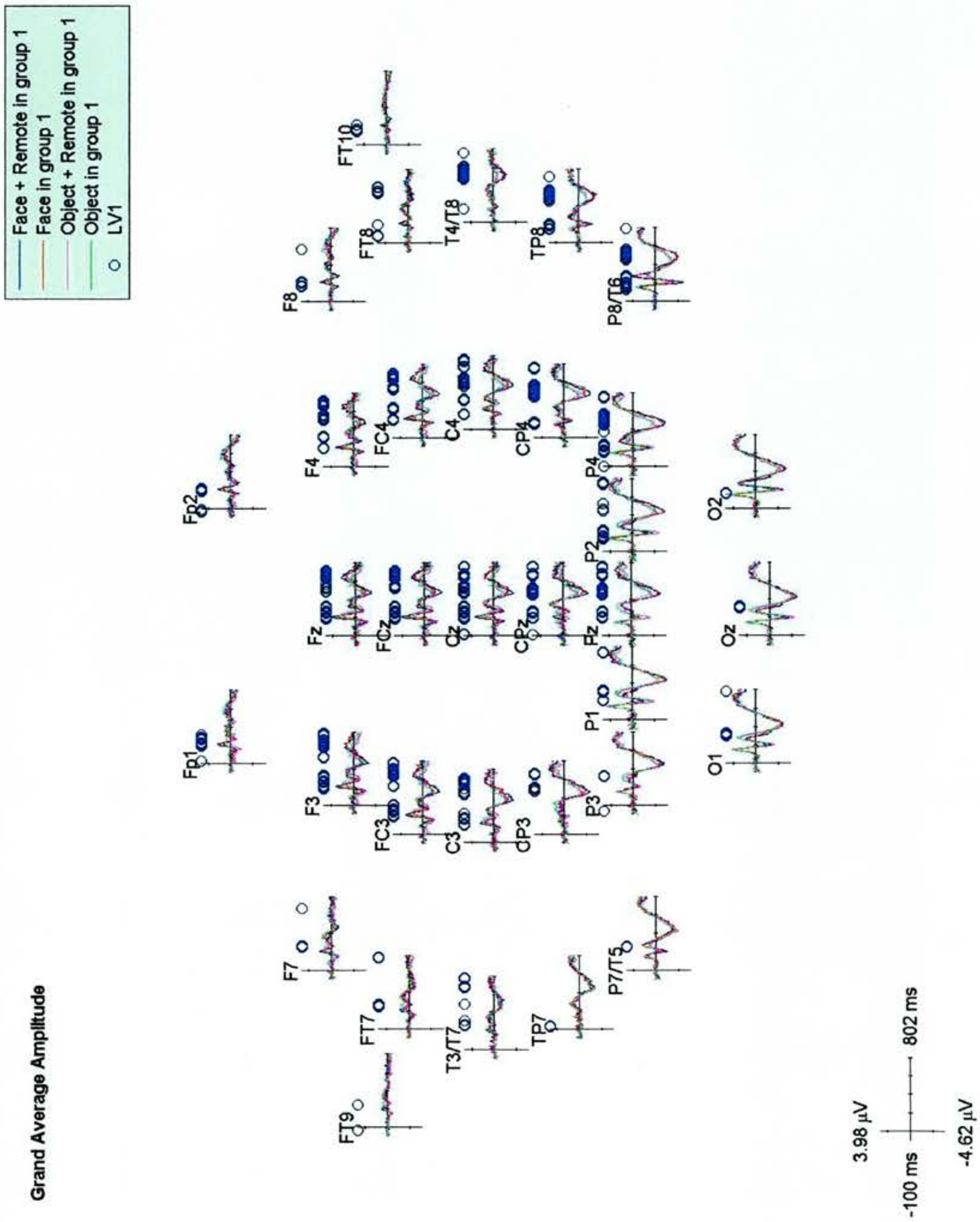

Figure 7.30: Bootstrap ROIs at the 95% confidence interval for Latent Variable 1 (LV1) for all electrode sites

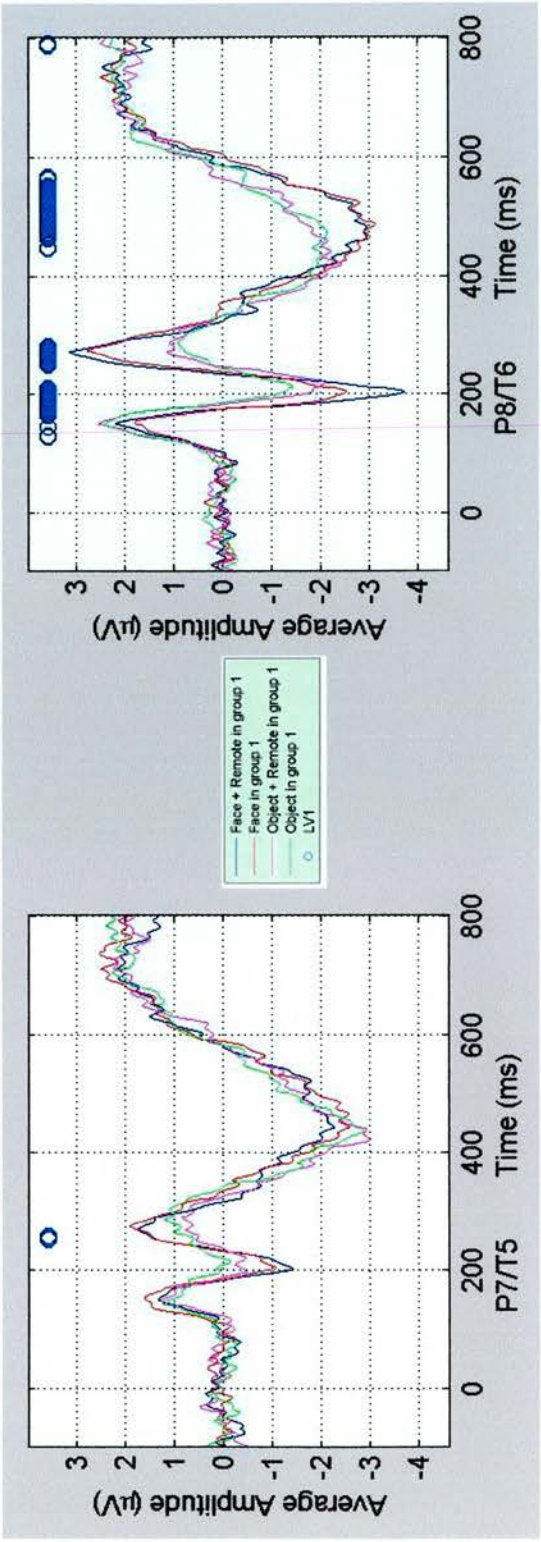

Figure 7.31: Comparison of Bootstrap ROIs at the 95% confidence interval for Latent Variable 1 (LV1) for electrodes P7 & P8

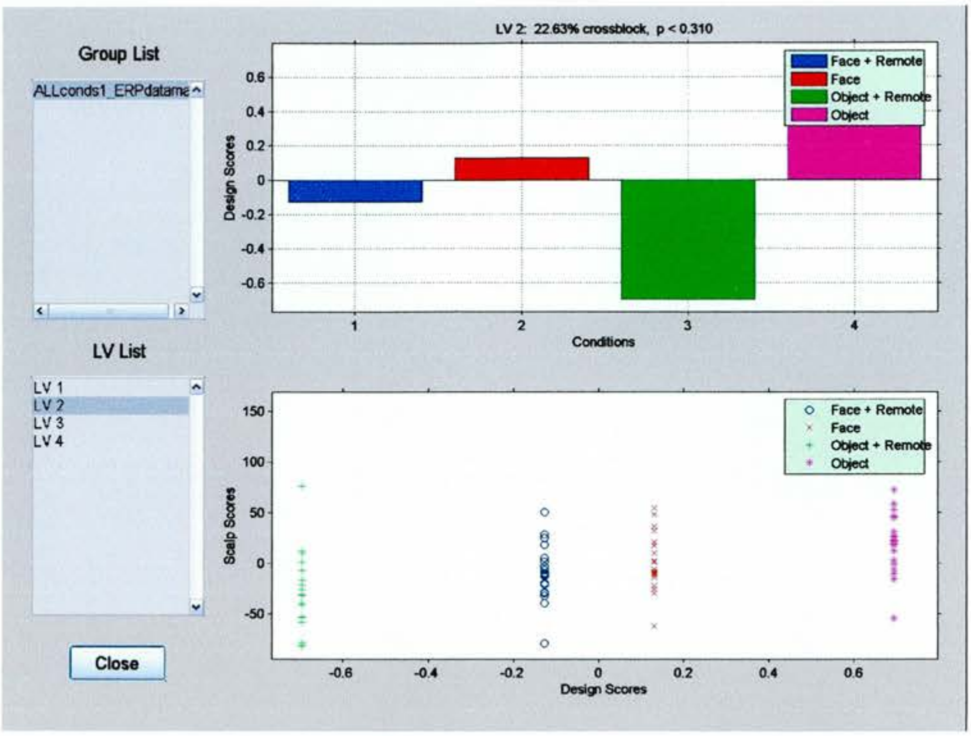

Figure 7.32: PLS model for Latent Variable 2 (LV2)

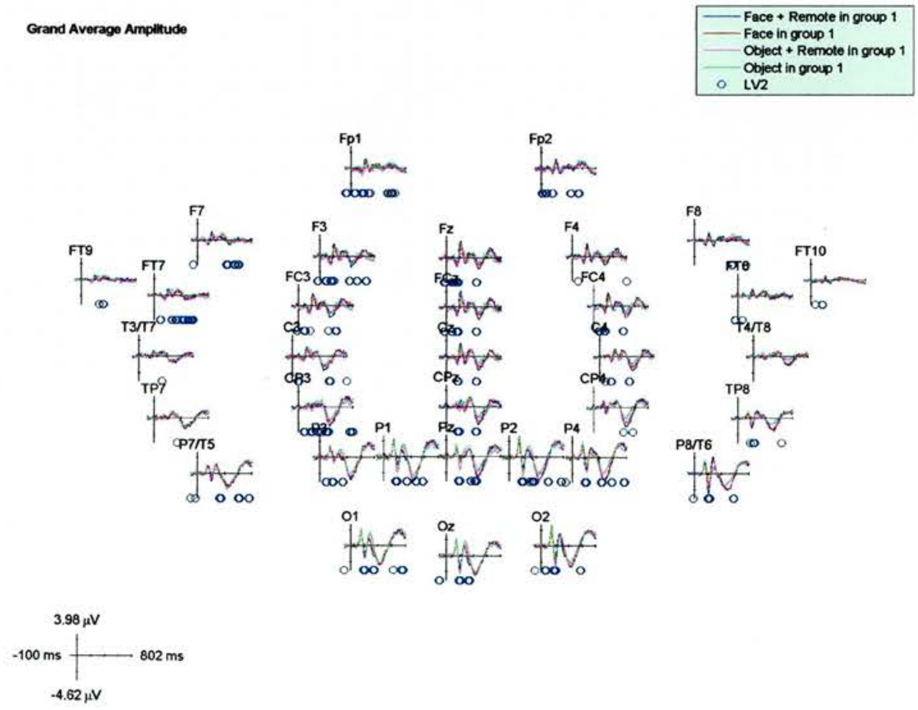

Figure 7.33: Bootstrap ROIs at the 95% confidence interval for Latent Variable 2 (LV2) for all electrode sites

whatever other processing is going on at the time, it is actually strengthening the modelling of the LV1 differences between the overall face (i.e., face, and face + remote stare) and object (i.e., object, and object + remote stare) processing conditions, leaving only non-significant remnants of the remote staring effect to be modelled and explained by LV2.

7.3.4.6 Summary of the *post-hoc* analyses

The analysis of the face processing effect at the P8 (T6) electrode demonstrated interesting region-specific differences when compared to the overall GFP differences. Firstly, analysis of the initial P1 component (150ms) demonstrated no significant differences between any of the conditions. However, analysis of the second component, N1 (208ms) suggested that there were significant differences between the face and object conditions, and for the processing of a remote stare, which appears to be driven by the face and the face + remote stare conditions comparison specifically. In contrast to the overall data, there was also a localised P2 component (272ms), which showed a highly significant difference between the face and object conditions, but no significant effect of the remote staring processing.

Additional analysis of the skin conductance data which examined the first 8 and 16 presentations of each stimulus failed to find any significant effects of the remote stare processing, or between face and object processing, for either of the presentation sets. This suggested that habituation was not a factor in the main analysis, but that there was no significant impact of the experimental manipulations on the skin conductance measure.

The frequency analysis of the alpha band over the full five seconds suggested no significant differences between the different conditions. However, this could be partially explained by the event-related bandpower analysis (ERBA). This analysis suggested that the majority of the processing is evoked in origin, with little contribution from the induced activity. As the frequency analysis incorporates all processing regardless of phase, and the induced activity is often of a higher overall amplitude than the evoked activity[14], the induced activity could be smoothing out the processing differences present in the evoked analyses, leaving no significant differences for the frequency analysis. The ERBA analysis also suggested that the main frequency contributions to the processing of the different stimuli are from the Theta to the Low Beta range (4 to 20Hz), and

[14]The evoked activity in the ERBA analysis is often measured in nanovolts (nV), compared to the induced activity which is often measured in microvolts (μV).

the evoked components of these frequency bands should be focussed on in future research.

Finally, the PLS analysis significantly modelled the face and object processing effects, and confirmed that the peaks used in the main GFP analysis were valid. However, due to the fact that the remote staring effect appears to act upon other processes that are occurring at the same time, the analysis was unable to significantly model the remote staring effect separate to the far larger face and object processing effects.

7.4 Discussion of the second experiment

Even though this experiment is complex and essentially represents several experiments rolled into one, the results appear to demonstrate a consistency regardless. The overall and most important finding is that remote staring detection appears to have a significant impact upon the global processing of other stimuli, regardless of what those stimuli might be. In addition to this, the importance of finding a significant difference between face and object processing should not be underestimated, particularly because finding this effect helps to confirm the validity of the methods used.

The main analysis of the EEG data involved the GFP analysis examining the global processing of each stimulus across all of the participants. This analysis demonstrated that the addition of a remote stare significantly changes the processing of other stimuli, and that this effect is not specific to faces, but can affect the processing of objects as well. The effect of the remote stare increased the peak amplitude, which is in contrast with the findings from the first study, which found that the addition of a remote stare reduced the peak GFP amplitude.

The localised analysis of the differences between face and object processing demonstrated that faces were being processed significantly differently to objects at areas of the cortex that have previously been identified as being heavily involved in face-specific processing. Interestingly, the effect of a remote stare on these processes mirrors the effect on a global level. The addition of a remote stare created a greater amplitude deflection for the processing of faces, than the processing of just faces on their own. This finding suggests that remote staring detection heavily mirrors and impacts upon other processes, but without necessarily having a substantial processing load in its own right. This is demonstrated clearly by the findings of the PLS analysis, that was able to model a significant face versus object processing effect, but was not able to significantly model the effect of the remote staring effect, primarily because this effect demonstrated very similar temporal and amplitude characteristics to the other face or object processing that was happening co-currently.

The mirroring of other processes by the remote staring detection is also demonstrated in the event-related bandpower analysis, suggesting that the neurological components of the potential remote staring detection process are distributed not only globally, effecting various sub-processes, but also across frequency bands. This effect impacts upon all levels of other processes, without dominating particular frequency generators. The activity is also dominant in the evoked component of the processing, once again acting upon the evoked-dominant face and object processing. The influence of these processes on the evoked activity is far more prevalent than the induced activity, so much so that the fast fourier transform analysis is unable to detect differences because the induced activity is blanketing the evoked activity.

Interestingly, the skin conductance activity is not showing any significant effects for the remote staring processing as suggested by other studies, particularly by the meta-analysis by Schmidt et al. (2004). Even the analysis of the earliest stimulus administrations failed to find a significant effect, suggesting that habituation to the stimuli was not a factor. However, it is difficult to directly compare the skin conductance data from this experiment and previous experiences as there are considerable differences in the methodologies. In order to provide the relevant signal-to-noise ratio for the GFP and ERP analyses, it was necessary to conduct as many stimulus administrations as possible in this experiment. As participants could only comfortably take part in the experiment for a finite period of time, it was necessary to dramatically reduce the stimulus intervals. In previous remote staring studies, a period of 30 seconds was often used as the amount of time that a participant was exposed to the remote staring stimulus (or a control period). In this experiment it could only be a maximum of five seconds. Therefore the form of remote staring effect on skin conductance activity noted in previous research might rely upon a longer period of exposure before reaction. As skin conductance reacts several magnitudes slower compared to electrocortical activity, the experimental design used here suggests that it is optimal for examining the faster, cortical reaction to a remote stare stimulus, but it might not be ideal for measuring the slower, skin conductance reaction.

The questionnaire measures appear to be largely irrelevant to the electrophysiological activity. The relatively small number of participants in the experiment may have contributed to this lack of an effect as there might not have been enough of a diverse sample for the questionnaire measures to be significant. However, although the questionnaires used had a theoretical justification for their use (as reviewed in section 3.4 on page 40), this lack of an effect could be because they are not the appropriate measures to examine the psychological variables of remote staring detection. This might be because remote staring detection has no relationship with questionnaire measures of anxiety, shyness, self-consciousness, etc. Remote staring detection might represent a phenomenon that is not necessarily moderated by these variables, but is a more primitive form of processing that makes its presence known by impacting upon other processes that are happening at that time. Or, it could be that the relationship of this phenomenon and psychological variables is different to what might be superficially evident. Although there is an assumption that an awareness of being stared at might be moderated by factors such as anxiety, etc, the nature of the phenomenon might not even represent a reaction to 'being stared at' *per se*. The effect might represent the participant scanning their environment for particular types of stimuli, and reacting to them. The concept of a 'remote stare' itself might be irrelevant. The name of this phenomenon, which has been debated in previous literature (I. S. Baker, 2005), might be completely incorrect. It might not represent a reaction to being stared at remotely, nor some type of distant mental interaction (i.e., DMILS), but a radically different phenomenon altogether. Different phenomena in parapsychology are often incorporated together in the literature based upon only a circumstantial phenomenological similarity, or because of minimal theoretical assumptions. Although it can be useful at times to consider remote staring detection within a DMILS-esque framework, it may also serve to constrain the theoretical development in the understanding of this phenomenon.

This research represents a challenge to the established body of literature on remote staring detection. It suggests that it is possible for a staree's brain to process the effect of a remote stare very rapidly, within the first few hundred milliseconds, and potentially without any reaction measurable from peripheral physiological activity (e.g., skin conductance). However, there are two fundamental issues that this experiment and the one before it raise.

Firstly, these two experiments are dealing with an interesting effect that shows a certain degree of replication. The nature of this replication is not perfect, but they do demonstrate a reaction to the remote stare stimulus, and also neatly highlight the transient nature of parapsychological effects. For example, there was a reversal in the effects of the remote stare between the studies reported by

Wiseman and Schlitz (1997) and Wiseman and Schlitz (1999). There is also a reversal of the main effect between the experiments reported here. In the first experiment, the effect of the remote stare served to *decrease* the peak amplitudes of the global activity to faces, in this experiment it *increased* these peaks for both faces and objects. Further experimentation is required in order to pin-point the reason for this reversal.

Secondly, there is an issue about whether or not the effects noted in the experiments reported here are due to *one person staring remotely at another person*. Although the experiments are carefully controlled to prevent artefacts, there is an issue of just exactly what this effect is demonstrating. Further experiments need to manipulate the remote staring stimulus, perhaps in the same manner as Braud et al.'s (1993b) 'sham' condition in order to better understand the nature of this effect.

Chapter 8

Understanding the Remote Staring Detection Effect

8.1 Introduction

The results from the second experiment suggest that the addition of a remote stare has a significant effect upon the electrocortical processing associated with viewing a face or an object. However, the findings of the second experiment also suggest two very important questions that need to be addressed, namely: (a) why was there a reversal of the effect between experiment one and experiment two, and (b) is it an effect of someone watching you remotely, or some other process or artefact?

The first issue is a complex one. Because these experiments are the first of their kind, it is very difficult to compare these findings with previous research. Although there is a history in parapsychology of effects reversing (e.g., the reversal of effect between the 'trained' and 'untrained' participant groups in Braud et al.'s (1993a) study) or disappearing, it is unclear why such a reversal has taken place in these experiments. One possible explanation is that the second experiment was not an exact replication of the first experiment. The change in the experiment design essentially involved the removal of the blank screen stimuli and their replacement with object stimuli. However, this change may not have been as straightforward as it might first appear. Although the stimulus presentation in both experiments followed the same fixed schedule intervals, from the point of view of the participant the experience of the stimuli in the first experiment was different from the experience of the second experiment. Due to the randomised and counterbalanced design of the face and blank screen conditions combined with the rest period, the face (or face + remote stare) stimuli effectively appeared at pseudo-random intervals in the first experiment. In contrast, the stimuli in experiment two followed a schedule where a stimulus (a face or an object) would appear on the screen at fixed, five second intervals (10 second intervals when the rest period is included). Therefore, the change in the direction of the effect between the two experiments may have been due to a comparison between a response from a relatively randomly-appearing stimulus, and a fixed-interval stimulus. Effectively, there may have been different forms of activity being generated during the different experiments. The ERBA results of the second experiment suggested that the majority of the processing of both the face and object stimuli was coming from the Theta to Low-Beta (i.e., 4 to 20Hz) range of evoked cortical activity, with a large contribution from the Alpha band (i.e., 8 to 13Hz). The remote staring detection effect appeared to be related to this processing activity, but to a higher amplitude. In addition to this, the first study suggests that remote staring detection does not generate activity in its own right (as shown by the comparison between the remote staring condition and the control condition). The results from the first and second studies also suggest that remote staring detection operates upon whatever other processes are currently active (i.e., face or object processing), increasing or decreasing the peak amplitude of the activity. If this is the case, then remote staring detection might operate on the sub-processes which make up a particular ERP. The ERBA analysis of the evoked alpha activity supports this, with a greater peak alpha activity for conditions with a remote stare compared to conventional processing conditions. A regular stimulus presentation, as used in experiment two, would naturally generate a greater degree of overall alpha-wave activity as the participant becomes more relaxed by the repetition. In contrast, irregular stimulus presentation, such as that used in experiment one, might be conducive to alpha-suppression, as the participant is more surprised or stimulated at the unpredictable presentation of a stimulus. As the ERBA analysis of experiment two suggests that alpha activity is important to the processing of faces and objects, then any processes that naturally enhance or inhibit the activity that is currently active would capitalise on this. The electrocortical activity associated with remote staring detection might be accentuating the activity of the conventional process. So, in the first experiment, the appearance of a face at irregular times was creating a suppression of alpha activity, and processing in the face + remote stare condition was following this trend and suppressing the alpha activity further. In contrast, the regularity of the appearance of the stimuli in the second experiment was creating a greater degree of alpha activity, and the processing in the face or object + remote stare conditions was increasing the amount of alpha activity further. In order to test this theory, further experiments need to manipulate the presentation of the stimuli. Theoretically, if the stimuli were presented in a similar, regular way mirroring the method used in the second experiment, this should produce a greater degree of alpha activity, which the remote staring detection should capitalise on, resulting in a higher peak ERP for the conditions in which a remote stare is added.

The second issue that needs to be examined is the legitimacy of the effect itself. The results of the first two experiments suggest that the remote staring manipulation has a significant effect on electrocortical activity, but there is no guarantee that the effect is definitely caused by the remote staring of another person. Although the experimental methods involve elaborate and extensive controls to restrict the chances of an artefact being present, the controversial nature of these experiments means that any effect needs to be scrutinised for potential artefacts. Even if the introduction of an artefact is eliminated, there are important theoretical concerns for an effect of this type. Although the previous studies suggest an interesting effect, it is currently unclear if the effect is caused by remote staring detection in the brain of the staree. It is unknown if the nature of the this interaction takes place by the staree actively monitoring or scanning their environment and responding to the presence of a stare, or if the starer is sending some kind of signal that is changing the brain activity of the staree. It could also be a combination of these two factors, or the effect could also potentially represent some form of dyadic correlation in the brain-states of the two individuals. It is unclear if the staree is detecting the actual stare of the other person in some way, incorporating information about their eyes, face, expression, etc, or if the staree is reacting to the intent of the individual, which is merely expressed via a remote stare.

There is an entire research program in the questions and issues that have been raised above, but the central questions involve: (a) the issue of the reversal of the effect between experiments one and two, and (b) whether the effect is legitimate. The experiment outlined here attempted to answer both of these questions. The first issue was tackled by partly replicating the last study. The experiment used the 'Face' and the 'Face + Remote Stare' stimuli that proved successful in both of the previous experiments, but used the same stimulus administration as the second experiment. This involved the stimuli being administered at regular intervals in a randomised and counterbalanced order which, it was hoped, would give more information on the nature of the effect and why it reversed between the two previous experiments. The second issue was addressed by the removal of the remote starer altogether. The idea behind this was, if the remote staring was producing the effect, then the removal of the remote stare should, in theory, remove the effect. A *split-half* design was used, which was randomised and counterbalanced across participants, where the 'Face (starer present)' and the 'Face + Remote Stare (starer present)' stimuli were administered for one half of the experiment, similar to the previous experiments, and the other half of the experiment the starer was removed. This provided a 'Face + Remote Stare (starer absent)' condition, where the presence of a remote stare was a sham (similar to Braud et al.'s (1993b) 'Sham' remote staring experiment condition), and a 'Face (starer absent)' condition, which was effectively the same as the 'Face (starer present)' condition and acted as an internal control to the experiment. By comparing the different conditions it was possible to gain a greater degree of insight into what the 'remote staring effect' actually represents.

8.2 Method

The method for this experiment was virtually identical to that used in the previous two experiments, the core method being described in the method section of the first experiment (see section 6.2, beginning on page 112) and the changes to the experimental equipment being outlined in the method section of the second experiment (see section 7.2, beginning on page 142). In order to limit the duplication of information, this method section simply details any differences in this experiment from the method previously described.

8.2.1 Participants

20 participants took part in this experiment (10 males and 10 females).[1] The average age was 27.8 years old (ranging from 18 to 50 years old). Participants were paid five pounds to take part, and the majority of them were right-handed (two were left-handed). None of the participants had taken part in any of the previous studies, or had completed the on-line remote staring detection survey.

[1]The experiment involved the testing of 26 participants, but only the data from 20 participants is included in the EEG analysis. The data from one participant had to be removed due to self-removal from the experiment, and the data from a further five participants had to be removed before the EEG analysis due to excessive noise artefacts.

8.2.2 Materials & Equipment

The experimental computer equipment, EEG computer and system, skin conductance measurement set-up and equipment, and use of personality questionnaires were all identical to those used in the second experiment.

The program controlling the entire experiment administered the following four conditions, which have differences from the previous experiments:

- *Face (starer present) condition* — In this condition the participant could see a picture of the experimenter staring directly at them (the same image used in the two previous studies). During this time the experimenter (who was also acting as starer) would be looking at a black screen.
- *Face + remote staring (starer present) condition* — In this condition the participant could see a picture of the experimenter, and the experimenter would see a live video feed of the participant.
- *Face (starer absent) condition* — In this condition the participant would see a picture of the experimenter, and there was a black screen on the starer's monitor, although the starer was not present. This was effectively the same as the Face (starer present) condition, and was included in order to complete the design.
- *Face + remote stare (starer absent) condition* — In this condition the participant could see a picture of the experimenter, and a live video feed of the participant was projected on the starer's monitor, although there was no starer present.

The image of the experimenter was the same image file in all of the conditions. The relationship between these different conditions is more clearly evident in table 8.1.

	Face Displayed	Face + Remote stare
Starer present	*Face (starer present) Condition*	*Face + Remote stare (starer present) Condition*
Starer absent	*Face (starer absent) Condition*	*Face + Remote stare (starer absent) Condition*

Table 8.1: 2 × 2 table of the independent manipulation

In the previous experiments, all four of the conditions were randomised and counterbalanced throughout the experiment. However, such a design was not possible in this experiment as it would have been very difficult to ensure that the starer left or entered the room at random intervals that could be as short as 10 seconds. Therefore, the experiment was randomised and counterbalanced in two different ways. Firstly, the order of the 'starer present' and 'starer absent' conditions were randomised and counterbalanced for the entire experimental run, so that half of the sessions meant that the starer was present for the first half of the experiment (i.e., the Face (starer present) and the Face + Remote stare (starer present) conditions), and was absent for the second half of the experiment (i.e., the Face (starer absent) and the Face + Remote stare (starer absent) conditions), and this order was reversed for the other half of the sessions. In addition to this, the order of the individual conditions within a particular half the session was also randomised and counterbalanced. The programming of the stimuli was undertaken by a third party[2] in order to ensure that the experimenter had no knowledge of the randomisation sequences prior to testing. The complex stimulus ordering cycle ensured that the presence of the starer could be manipulated within the experiment, and yet prevented stimulus-specific artefacts that could be introduced due to the natural linear decline of many physiological factors over time.

The EEG was sampled using the same parameters as those used in the second experiment, with each condition was presented 60 times. The staree's eyes were was approximately 150cm from the screen, with the screen and camera located directly in front of them.

8.2.3 Hypotheses

The hypotheses for the experiment were as follows:

1. There will be a significant difference between the peak GFP amplitudes of the face (starer present) condition, and the face + remote stare (starer present) condition.

2. There will be a significant difference between the peak GFP amplitudes of the face + remote stare (starer present) condition, and the face + remote stare (starer absent) condition.

3. There will be significant differences between the mean level of skin conductance response to the face (starer present) condition compared

[2] I would like to thank Dr Paul Stevens for writing this program. This program was identical to the program used in the second experiment, except for the removal of the object stimulus and the alterations in the randomisation sequence.

to the face + remote stare (starer present) condition, and between the face + remote stare (starer present) condition and the face + remote stare (starer absent) condition.

4. There will be a significant correlation between the SCS and paranoia questionnaire factors, and the subtracted difference between the peak GFP values of the face (starer present) and face + remote (starer present) conditions, and for the subtracted difference between the peak GFP values of the face + remote (starer present) and the face + remote (starer absent) conditions.[3] There will be significant correlations between the questionnaire measures and the mean skin conductance responses for these subtracted conditions also.

8.2.4 Procedure

The procedure for the experiment was virtually identical to the procedures used in the previous experiments (see section 6.2.4 on page 117). A pilot study involving two participants was conducted before the main experiment, and resulted in no changes to the experimental procedure or measures.

The only procedural differences between this experiment and the previous experiments were due to the removal of the starer during half of the experiment. Once the participant was located in the staree's room and the system had been activated, the experimenter proceeded to the starer's room, where the computer program would indicate whether or not a starer should be present in that particular half of the experiment.

The participant was not informed of the experimental manipulation concerning the presence or absence of a remote starer until the experiment was completed, when the experimenter explained the nature of the experiment and how it was testing the phenomenon of remote staring detection.

8.3 Results

The data from the experiment was analysed using the Edit package of NeuroScan's Scan 4.3.1 EEG processing suite, SPSS 12, and the R analysis environment (Version 1.9.0). Perl and Tck/TL scripts were used to extract the data, and examples of these can be seen in Appendix B on page 254.

[3]These are a difficult comparisons, but the best index of successful discrimination of the remote staring stimulus is to subtract the peak GFP values between these different conditions.

8.3.1 System Latency Test

As had been outlined in previous sections (please see section 7.3.1 on page 146) it is necessary to test the system latency for any experimental system where accurate timing is vital. The system latency was calculated by attaching a photoelectric diode to the staree's computer screen, that was then attached to the EEG amplifier. By comparing the voltage change generated by the photodiode to the trigger onset, it is possible to estimate the system latency. This test was repeated four times and involved all of the four experimental stimulus conditions.

The results of the system latency test are shown in figure 8.1. They clearly show that the onset of the voltage deflection (when the image was detected by the photodiode), which is the indicator of the system latency, was at 122 milliseconds and that this is consistent across all of the conditions.

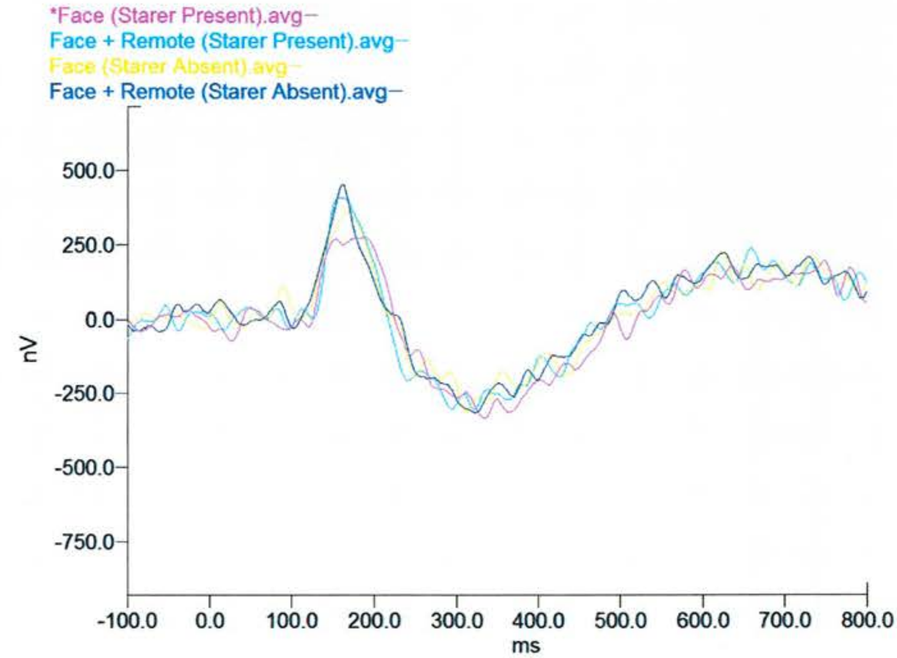

Figure 8.1: System test results for all four conditions (in nanovolts)

8.3.2 Data Preparation for ERP analysis

The EEG data was pre-processed in order to remove artefacts in the same manner that the data for the second experiment was pre-processed (see subsection 7.3.2 on page 148), and the procedure is summarised here. Ocular artefacts were removed using the vertical (bipolar) electrooculargram channel, with 30 sweeps at 400ms derivation, with a positive trigger at 10% threshold. The data was bandpass filtered from 1Hz (24dB/oct rolloff) to 30Hz (24dB/oct rolloff), and then epoched into all four conditions[4], with an epoch length of −100ms to +800ms. A baseline correction was then performed to baseline to the pre-stimulus period. The data was then scanned for artefact rejection (−75μV to +75μV threshold) followed by a visual inspection of the data. Finally the data was averaged into the different conditions.

8.3.3 Hypothesis testing

8.3.3.1 Event-related potentials analysis

As with the previous studies (see subsection 7.3.3.1 on page 149), the main measure for this experiment was Global Field Power and the peaks for analysis were identified by averaging together all of the GFP values for all of the conditions, which can be seen in figure 8.2. Two discreet components were identified at 120ms and at 174ms, and the means and standard deviations for all four conditions at these two peaks is shown in table 8.2.

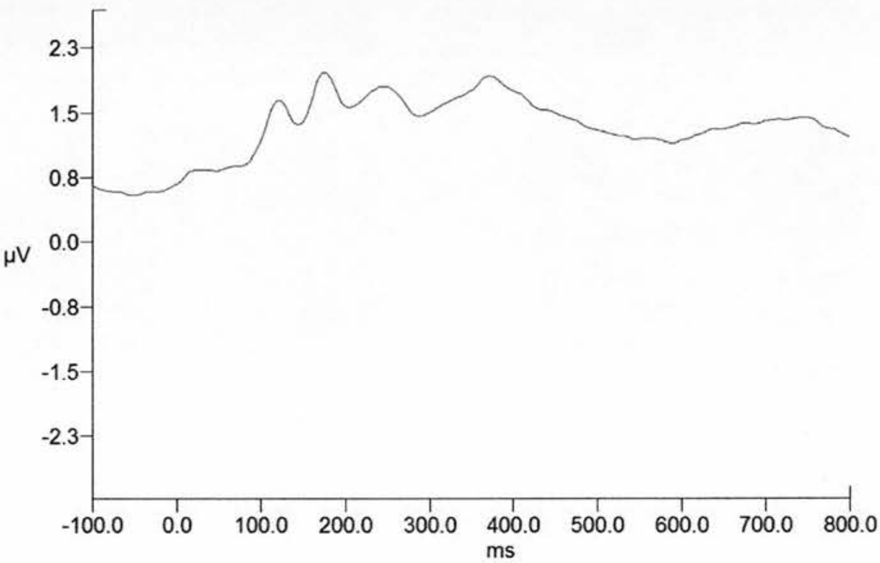

Figure 8.2: Overall GFP of all participants across all conditions

The Grand Average (i.e., the average of all 20 participants) GFP results for each condition are shown in figure 8.3, and they demonstrate the difference in

[4]Similar to the previous experiments, all of the conditions were subjected to artefact rejection simultaneously in order to prevent particular conditions from being treated differently than others, which could artificially impact on any potential effects.

Condition	*120ms*		*174ms*	
	Mean	SD	Mean	SD
Face (starer present)	1.43	.51	1.63	.67
Face + Remote (starer present)	1.68	.66	2.31	.81
Face (starer absent)	1.61	.59	1.74	.59
Face + Remote (starer absent)	1.83	.58	2.16	.82

Table 8.2: Means (in μV) and standard deviations of the GFP values for the two peaks of interest for the four experimental conditions.

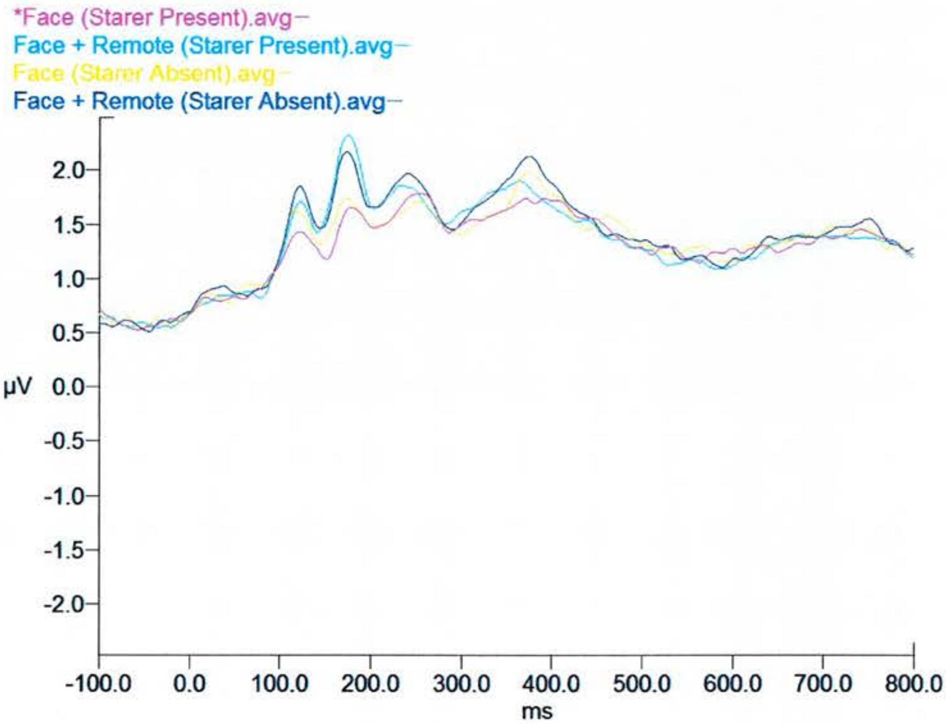

Figure 8.3: GFP of all participants and all four separate conditions

Condition	120ms Peak		174ms Peak	
	Shapiro-Wilk[a]	p	Shapiro-Wilk	p
Face (starer present)	.949	.347	.992	.107
Face + Remote (starer present)	.927	.137	.961	.557
Face (starer absent)	.938	.220	.965	.637
Face + Remote (starer absent)	.951	.388	.949	.350

[a] $df = 20$ for both peaks.

Table 8.3: Shapiro-Wilk Test for normality on the GFP data distributions

GFP activity between conditions, particularly at the 120ms and 174ms peaks, as identified in the combined GFP analysis. Because the GFP peak distributions were all demonstrated as being non-significant for the Shapiro-Wilk test (see table 8.3), it rejects the assertion that the data is not normally distributed. Therefore, 2 × 2 ANOVAs (remote staring × presence of starer) were used to test for the effects for each peak of interest.[5]

The ANOVA for the initial 120ms peak suggested a significant effect of remote staring detection ($F_{(1,19)} = 10.182$, $p = .005$), and for the presence of a starer ($F_{(1,19)} = 12.013$, $p = .003$), but with no significant interaction between these two factors ($F_{(1,19)} = .006$, $p = .868$). The ANOVA results for the 174ms peak also suggested a significant effect of remote staring detection ($F_{(1,19)} = 54.890$, $p < .001$), but no significant effect for the presence of a starer ($F_{(1,19)} = .027$, $p = .871$), and no significant interaction ($F_{(1,19)} = 1.720$, $p = .205$). In order to explore and to understand these effects further, paired t-tests were conducted on the GFP peaks.

The initial 120ms peak shows a significant difference between the face (starer present), and the face + remote stare (starer present) conditions ($t_{(19)} = -2.159$, $p = .044$, *Cohen's* $d = .437$), and a non-significant difference between the face + remote (starer absent), and the face + remote (starer present) conditions ($t_{(19)} = -1.212$, $p = .241$, *Cohen's* $d = .236$). The second peak at 174ms also shows a significant difference between the face (starer present), and the face + remote stare (starer present) conditions ($t_{(19)} = -5.560$, $p < .001$, *Cohen's* $d = .912$), but it does not demonstrate a significant difference between the face + remote (starer absent), and the face + remote (starer present) conditions ($t_{(19)} = .887$, $p = .386$, *Cohen's* $d = .182$).

8.3.3.2 Skin conductance analysis

The skin conductance (SC) data from each participant for their entire session was normalised using a z-transform, which was summarised by equation 7.1 on page 152. As with the last experiment, the data from each individual administration of a stimulus was then averaged by condition to provide a mean, standardised value of the skin conductance response for each condition. The mean skin conductance values for the 20 participants that were used in the EEG analyses is shown in figure 8.4.

[5]Modified alpha for this analysis was calculated as: $\alpha_{MB} = .025$ (as outlined in section 6.4.2.1 on page 124). This modified alpha was only used for the ANOVA analyses and not for the t-tests, as these were secondary analyses exploring the effect once the main effect had been established.

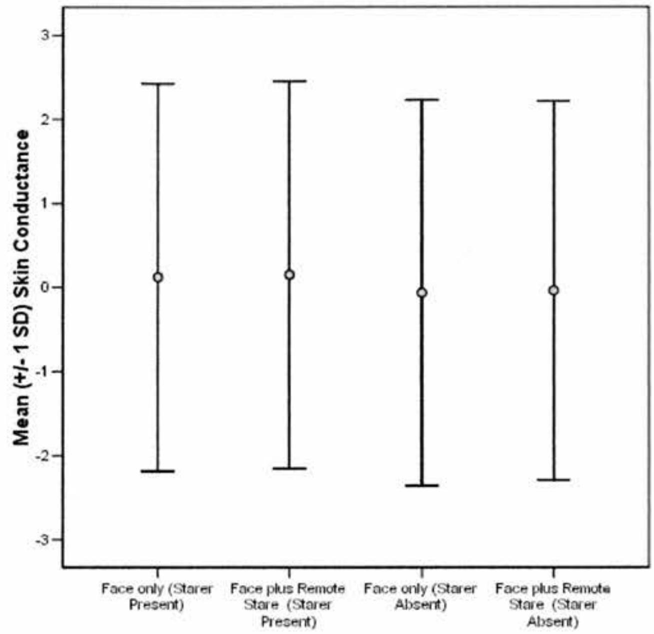

Figure 8.4: Mean normalised skin conductance activity (with ± 1 standard deviation) for all four conditions for all 20 participants in the main EEG analysis.

A second analysis was also conducted on all of the participants that were tested during the course of the experiment, as the noise artefacts that affected the EEG data of the five participants that were removed from the EEG analysis did not affect the skin conductance data, and therefore the data could be analysed.[6] The mean skin conductance values for all 25 participants is shown in figure 8.5.

The data from both samples of participants did not significantly violate the assumptions for normal data distributions (as examined by Shapiro-Wilk tests), and therefore parametric statistics could be used in the analysis.

A 2 × 2 ANOVA (remote staring × presence of starer) analysis of the skin conductance responses for the 20 participants that were used in the main EEG analysis suggested that there were no significant effects for remote staring detection ($F_{(1,19)} = 1.329$, $p = .263$), or for the effect of the presence or absence of a starer ($F_{(1,19)} = .034$, $p = .855$), or any significant interaction between these two factors ($F_{(1,19)} = .004$, $p = .953$).

A similar analysis of the skin conductance responses for all of the participants also suggested that there were no significant effects for remote staring detection ($F_{(1,19)} = 2.547$, $p = .124$), or for the effect of the presence or absence of a starer

[6]A total of 26 participants were tested, but the data from one participant could not be used due to self-removal from the experiment.

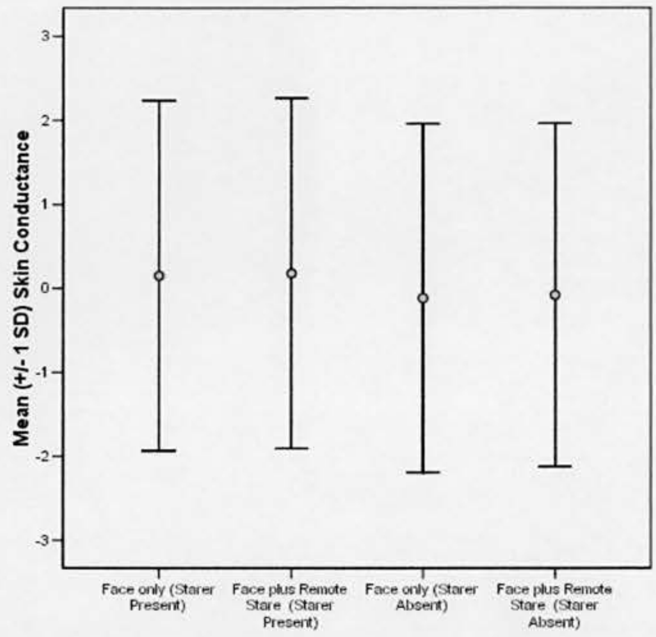

Figure 8.5: Mean normalised skin conductance activity (with $\pm$ 1 standard deviation) for all four conditions for all 25 participants.

($F_{(1,19)} = .101,\ p = .753$), or any significant interaction between these two factors ($F_{(1,19)} = .032,\ p = .86$).

8.3.3.3 Questionnaire analysis

The data from the SCS and paranoia questionnaires was compared with both the global field power data and the mean skin conductance results. The SCS was coded into the five factors suggested by Mittal and Balasubramanian (1987), and the physiological measures were recalculated in order to compare the questionnaires to the potential remote staring effect. In order to do this, the peak GFP and mean SC results for each participant's processing of the face (starer present) condition was subtracted from the face + remote stare (starer present) condition, as this subtracted value should theoretically remove any response related to the face and reflect the response to a remote stare. In addition, a similar subtraction was made between the face + remote stare (starer present), and the face + remote stare (starer absent) conditions, as again with the remote starer removed in one condition compared to the other, any GFP or SC differences remaining should be theoretically due to the response to a remote stare. All comparisons were two-tailed using Spearman's rho correlations. Due to the risk of familywise alpha over-correction and the increased risk of Type II errors (Bland & Altman, 1995; O'Keefe, 2003; Tutzauer, 2003), the alpha level of the correlations was not adjusted for multiple comparisons. The comparisons between the questionnaires and the mean skin conductance results focussed upon the data from the 20 participants whose data was included in the main EEG analysis, in order to provide a more direct comparison with the GFP results.

Significant negative correlations were found between the SC responses for the face + remote stare (starer present/absent subtraction) and internal state awareness ($r = -.453$, $p = .045$) and for private self-consciousness ($r = -.483$, $p = .031$), and significant positive correlations for this SC measure and for appearance consciousness ($r = .532$, $p = .016$) and for public self-consciousness ($r = .452$, $p = .046$). There were also significant negative correlations between style consciousness and GFP responses for the face + remote stare (starer present/absent subtraction) for the 120ms peak ($r = -.520$, $p = .019$), and for the face/face + remote (starer present) subtracted conditions for the 174ms peak ($r = -.527$, $p = .017$).

8.3.4 Summary of all results

The ANOVA results for the peak GFP comparisons suggests that there is a significant effect of both remote staring detection (for both peaks) and for the presence of a remote starer (for the 120ms peak). However, the very subtle differences between conditions are not necessarily reflected in these results and it is necessary to examine the t-test results in order to understand the potential effects. Although the t-test results support the suggestion that the addition of a remote stare is having a significant impact upon processing when the face (starer present) and the face + remote stare (starer present) conditions are compared, they do not support this suggestion when the face + remote stare (starer present) and the face + remote stare (starer absent) conditions are compared. As these two latter conditions are equivalent, apart from the manipulation of whether or not a starer was present, a lack of any significant difference between them for the results of one of the ANOVA tests and for both of the t-tests requires further investigation.

Similar to the results from the last experiment (see section 7.3.3.2 on page 152) there were no significant effects of remote staring or the presence/absence of a starer on the mean skin conductance of either of the participant samples.

There were several correlations between the psychophysiological measures and the questionnaire measures. Mean skin conductance measures of remote staring response appeared to correlate negatively with measures of private self-consciousness, and positively with measures of public self-consciousness. In contrast, some of the subtracted peak GFP measures of remote staring detection correlated negatively with measures of public self-consciousness. However, although there are arguments against familywise alpha adjustments in case of causing a Type II error, with a large amount of comparisons there is also an increased chance of a Type I error and therefore these correlations should be treated with caution. This is particularly important because there were no overall significant differences of the effects of remote staring or the presence/absence of a starer on the mean skin conductance results and, as will be seen in the discussion, also because of the ambiguity of the peak GFP results.

8.4 Discussion of the third experiment

The analysis of the GFP data initially suggests that there is a remote staring effect, as there is a significant difference between the peak GFP waveforms of the face (starer present) condition and the face + remote stare (starer present) condition. The addition of a remote stare when the participants are viewing a face appears to significantly increase the peak amplitudes of the global processing of the faces. However, this issue is complicated by the fact that there is no significant difference between the processing of the face + remote stare (starer present) condition, and the face + remote stare (starer absent) condition. The system was running the same program for both of these conditions. The only apparent difference between them is that in in the face + remote stare (starer present) condition there was a remote starer present, but in the face + remote stare (starer absent) condition the system displayed the live video feed, but there was no remote starer present. This suggests two possible explanations, firstly it could represent an unusual element of the processing of a 'paranormal' stimulus, where it is possible that the staree is constantly monitoring their environment in case of the *possibility* of being stared at remotely, and consequently showing a difference in processing compared to conventional face processing, but it is not necessary to have a remote starer present. This would represent a considerable challenge to many parapsychological theories that focus on the interaction between two systems, as the 'sending' system would become redundant, and the emphasis would be on the 'receiving' system actively monitoring its environment for any potential incoming stimuli.

However, there is a subtle, but key difference between the conditions in this experiment. The face (starer present) condition and the face (starer absent) condition, both operate with the live camera feed from the staree's camera being masked on the starer's screen, and these two conditions can be referred to collectively as the 'camera-masked' conditions. In contrast, the face + remote stare (starer present) condition and the face + remote stare (starer absent) condition both need the live camera feed to be unmasked, and therefore can be referred to together as the 'camera-unmasked' conditions. Although there could be a parapsychological effect as outlined above, the fact that the addition of remote staring in one condition (the face + remote stare (starer present) condition) has a significant impact on processing, but the absence of a remote starer does not remove this effect (in the the face + remote stare (starer absent) condition), suggests either a complex mechanism, or the potential for an artefact causing this effect. The fact that the 'camera-masked' conditions involve the same program code and share similar results, and the 'camera-unmasked' conditions also have the same code and share similar results, reinforces the possibility of an artefact. The nature of this artefact would have to be extremely subtle, as the difference in program code between the two sets of conditions only involves the placement or removal of a black image on the staree's screen to mask the camera feed. This artefact would have to involve a change in the properties of the image that is displayed on the staree's screen, as this is the only stimulus (apart from the possibility of a remote stare) that is administered to the participants. It was therefore necessary to perform further experimentation in order to discover if there was a potential artefact that might explain the significant effects noted above before investigating these effects with more in-depth analysis, as further analysis might just be examining the effect of the artefact rather than the nature of the remote staring effect itself. The optimal way to test for an artefact was to use a photodiode in order to examine any changes in the properties of the image on the staree's screen between one condition and another.

8.5 The photodiode experiment

8.5.1 Introduction

In this experiment a sensitive photodiode with a relative spectral sensitivity similar to the human eye (i.e., reacts to visible light) was used to simulate a human's response to the stimuli used in the third experiment. The experimental set-up, ambient light levels, and analysis were as similar as possible to the procedure for the third experiment, in order to prevent any artefacts being introduced as a consequence of the acquisition or analysis process. The only difference was that there was a photodiode reacting to the images instead of a person reacting to them. The aim of this experiment was to examine whether the experimental program was somehow altering the properties of the experimental stimuli between the different conditions, and this difference was accounting for the possible "remote staring effect". As the image file displayed on the staree's screen was the identical file for each condition, it is unlikely that there are any fundamental differences in the properties of the image from condition to condition (such as a difference in colour, etc). However, as the program used to run the experiment is more complex than many stimulus programs used in ERP experiments, it was necessary to evaluate whether the the stimulus presentation on the staree's screen was the same in both conditions.

In order to test this a simulation experiment was run, where a sensitive photodiode (BPW21, OSRAM Opto Semicondutors) was positioned 150mm away from the centre of the staree's screen (see figure 8.6 for an illustration of the photodiode's positioning) and the only light sources in the room were from the screen and the equipment. The relative spectral sensitivity of the photodiode compared to that of the human eye can be seen in figure 8.7, and although the photodiode has a very similar sensitivity to the eye, it has a slightly greater range and can therefore detect wavelengths of light slightly outside of the wavelengths than the eye can detect. The photodiode was connected to an oscilloscope[7] in order to record the changes in its millivolt output for the different stimuli. The stimuli tested were the 'face (starer absent)' stimulus, and the 'face and remote stare (starer absent)' stimulus. These two conditions had the same program code, except that in the former the code instructed the camera feed to the starer's monitor to be masked, and in the latter condition it was unmasked. This code was the same regardless of whether or not the starer was physically present (as per the experimental manipulation of the third experiment).

8.5.2 Results

The first test conducted on the different stimuli was to examine whether there was any differences in the overall output of the photodiode (and therefore luminance) between the two conditions for the full five seconds of exposure. There was no difference, with both conditions providing a mean output of 266 mV.

The second test conducted on the stimuli was a more specific analysis examining the luminance profiles at the onset of the image display. The profiles

[7]Gould Advance Digital Storage Oscilloscope OS4000, NATO Stock No: Z4/6625-99-647-3625.

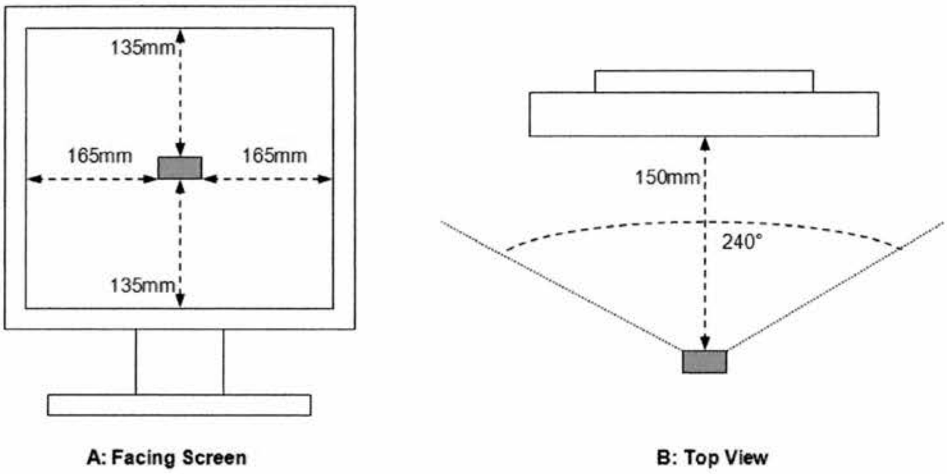

Figure 8.6: Diagram of the positioning of the photodiode (in grey) in relation to the staree's screen: Facing the screen (A), and above the screen (B)

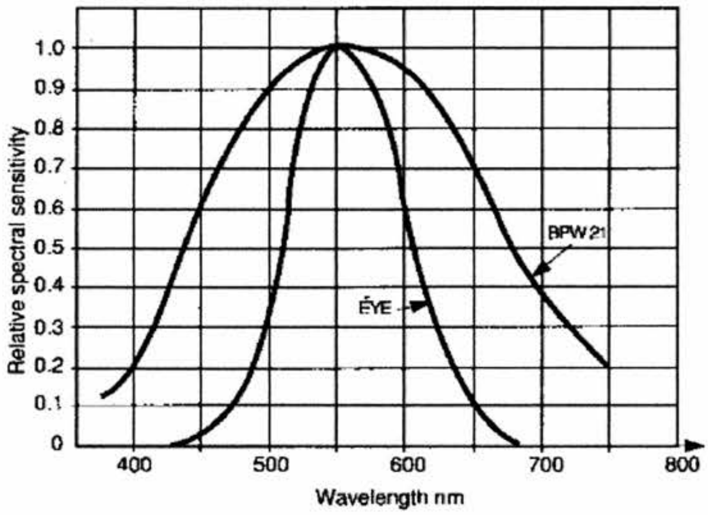

Figure 8.7: Relative spectral sensitivity to wavelengths of light for the BPW21 photodiode and the human eye (RS Components, 1998)

of both conditions obtained in this analysis consistently demonstrated a small step in the luminance increase to full luminance, this step occurring at a lower level in the face (starer absent) condition. This small difference is illustrated in the image capture of the oscilloscope shown in figure 8.8. This difference lasted for approximately 20 ms and ranged between 1 to 10 mV (primarily between 4 to 10 mV), which corresponds as approximately 0.03 to 0.2 Lux. This maximum value of 0.2 Lux corresponds to 2.5 candela/square metre (cd/m^2), and to 0.7 foot-lambert.

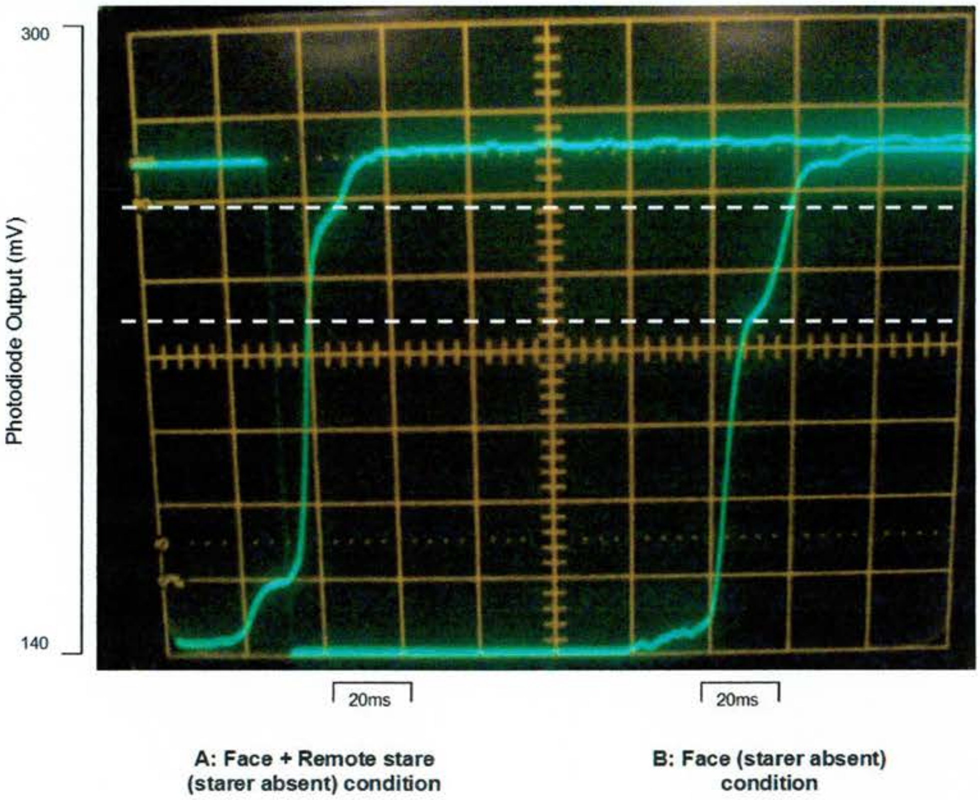

Figure 8.8: Image capture of the oscilloscope output of the luminance test demonstrating the difference in the signal step of the photodiode output for the different stimuli. The dashed white lines highlight the area of interest between the two waveforms.

This analysis suggests that, although there was no difference between the luminance levels of the images on the staree's screen once the image had drawn up to its full luminance level, there was a small difference between the images when they were being initially presented by the screen to their full luminance. This means that there could have been a approximately 20 ms period where one image was slightly lighter, or darker, than the other, which may have had an impact upon the corresponding ERP processing of that image.

8.5.3 Discussion

Although there is no difference between the overall luminance levels of the "face (starer absent)" (or "camera-masked") and "face and remote stare (starer absent)" (or "camera-unmasked") conditions, the small difference in the luminance profiles at the onset of the images may have resulted in participants processing the images slightly differently, resulting in different brain activity for each condition. It is important to compare these luminance differences to previous research in psychophysics on luminance sensitivity in order to attempt to establish if this difference is significant in terms of human functioning.

Research into luminance sensitivity and detection rarely appears to focus directly on the threshold that individuals demonstrate for being able to detect luminance differences under different conditions. Instead, luminance is often used as a vehicle to study other psychophysical or cognitive mechanisms. There are several areas of research that use this, but the main areas involve understanding the magnocellular and parvocellular pathways, particularly in colour perception[8] (e.g., Chaparro, Stromeyer, & Eskew, 1994; Mullen & Losada, 1994; Troscianko et al., 1996; Gowdy, Stromeyer, & Kronauer, 1999), and research on attentional cueing (e.g., Luck et al., 1994; Stuart, Maruff, & Currie, 1997; P. L. Smith, 1998). There is very little research examining the luminance detection threshold in its own right, possibly due to the complexity of the issue.

There are different methods for measuring luminance, using different distances from the participant to the stimulus, and it usually involves conscious detection. Kolb, Fernandez, and Nelson (2005) suggest that the absolute threshold of human luminance detection differences is approximately 0.00001 cd/m^2 after approximately 40 minutes in absolute darkness. This absolute threshold provides some information on the limits of the human visual system, but is not directly applicable in this case, as participants would have been looking for very subtle differences in luminance between two images on a screen at normal room level lighting, not in absolute darkness. In addition to this, the images were not presented simultaneously, but rather sequentially and separated

[8]The *lateral geniculate nuclei* (LGN) of the thalamus is layered with several two-dimensional sheets of neurons. The lower two layers are called the magno- and parvocellular cells. The magnocellular cells are sensitive to changes in contrast, have relatively large receptive fields, but are not very selective to colour. Conversely, the parvocellular cells are relatively insensitive to changes in contrast, have smaller receptive fields, and are highly selective to colour (S. E. Palmer, 1999). Hence this is why luminance and colour are both important factors when understanding the functioning of these pathways.

by a five second display of a blank screen, making comparisons between the images even more difficult, although they may have induced different forms of processing.

Peli, Yang, Goldstein, and Reevesi (1991) measured differences using luminance differences as low as 0.75 cd/m^2, however they noted that the ability to detect contrast differences at very low levels of luminance was log-linear, with it becoming steadily exponentially more difficult at lower luminance levels. Using simple patterns in a completely dark room, Plainis and Murray (2000) examined reaction time differences in only two participants to luminance images as low as 0.2, 0.02 and 0.005 cd/m^2, however they question the reliability of the reaction times at luminance levels this low. Their experiment differs from the experiments reported here, as they used a completely dark room, whereas these experiments took place in a conventionally lit room. They also compared foreground images to a background, which is easier compared to the experiment reported here, which used two completely separate images.

The most analogous ERP study to this simulation was that conducted by Johannes, Münte, Heinze, and Mangun (1995), which detected *non-significant* differences in ERPs when bar stimuli of different luminances were displayed on a screen. However, there are fundamental issues surrounding this experiment and its comparison to the simulation experiment. Firstly, the stimuli used were simple bar stimuli that have clearly defined boundaries. It is easier to detect differences in image luminance with such simple stimuli compared to the relatively complex face stimuli used in the third experiment. Secondly, one stimulus was set at 15.5 foot-lambert (bright stimulus), and the second was at 0.4 foot-lambert (dim stimulus), representing a huge difference in stimuli, suggesting that it is necessary to use stimuli with a difference of over 15 foot-lambert in order to obtain ERPs that are related to a difference in luminance. The maximum luminance difference between the stimuli in the simulation was approximately 0.7 foot-lambert, which is considerably lower than the luminance difference employed by Johannes et al. (1995). Finally, even with this comparatively large luminance difference involving simple bar stimuli, Johannes et al. (1995) still failed to obtain significant differences between the ERPs generated by the different stimuli. As significant differences were found between conditions using the global field power measure in experiment three, and the luminance differences between the stimuli were several magnitudes smaller than those used in Johannes et al.'s (1995) study, it is unclear if luminance difference could have produced the effects observed in the third study.

It is very difficult to measure differences in luminance between one stimulus and another, as there are a variety of methods and a number of confounding variables that can affect the measurement. This difficulty is compounded further by the fact that the majority of psychophysics experiments examining this issue, such as Plainis and Murray (2000), use the classic *threshold sensitivity* method, where participants are exposed to a stimulus of linearly increasing luminance until they can consciously indicate that they can visually detect a difference. However, it is clear that the potential visual differences between these stimuli are not consciously perceivable, but might be unconsciously perceivable. This would not necessarily have an effect on overt behaviour, but might have an impact on the very sensitive ERP measure as the brain processes these subtly different stimuli without the conscious mind being aware of it. Unfortunately, due to the threshold sensitivity measure, only consciously perceivable differences are of interest to most psychophysicists, and it is unclear what effect the luminance difference between the stimuli in this experiment might have on event-related potentials.

There are several factors that can complicate the measurement of luminance which need to be considered in future work. These include; the background luminance of the monitor, the background luminance versus the foreground luminance (or the luminance of the target itself), the distance of the observer from the monitor, the use of colour in the image (as changes in the luminance of certain colours are detected more efficiently than others), and the complexity of the target image (many experiments use simple geometric shapes or checkerboard patterns, and boarder discrimination helps in luminance discrimination). There are also factors such as the relative light levels of the test room (absolute darkness allows greater luminance detection), individual threshold sensitivity variation, moving images compared to static images, the *Weber-Fechner* law which suggests that the eye detects luminance shifts logarithmically, and finally that a measurement of the luminance of the entire image is required, rather than just a portion of it. However, possibly the most important issue is that many of the above issues have been identified for the conscious processing of luminance differences and there might be other issues surrounding the unconscious processing that can only be detected by using electrophysiological measures, such as event-related potentials. The experiments reported in this thesis circumvented some of these issues because the image file used covered the entire screen. As the luminance shifts appeared to be hardware-driven, possibly due to voltage shifts in the hardware[9], it should have altered the luminance of

[9]It is difficult to identify the exact mechanism behind these voltage shifts, as each monitor had a separate power supply, and the signal was transmitted to each monitor via a separate graphics card and monitor cable.

the entire screen uniformly, rather than representing luminance shifts within the image itself.

Although there are difficulties in comparing this simulation to previous psychophysics experiments that have examined luminance sensitivity, the previous literature suggests that it is very difficult for individuals to reliably detect and react to luminance differences as small as those suggested by this simulation, or to even produce differences in brain processing that is demonstrated by ERPs. However, as there is a difference, then the results from experiment three need to be considered in terms of a potential artefact that might be the cause of at least part of the effect noted. Even if it was possible to precisely estimate the degree of effect that such a subtle shift in image luminance might have, it is very difficult to establish in such a controversial area of research that any remaining effect is due solely to a "remote staring detection effect". It is essential that future experiments ensure that there are no luminance differences, no matter how small, between the different experimental stimuli, so that there can be greater accuracy in ascertaining the existence of a effect on brain activity from being watched remotely by another.

Chapter 9

Interpreting the Findings

9.1 Introduction

The findings from all of the research outlined in this thesis are summarised below, before being discussed collectively. Firstly, there are the results from the web survey, reported in Chapter 2, which examined the experiences and beliefs associated with remote staring detection from 588 respondents from all over the world, but primarily from the U.K and the U.S. The survey results suggested that there is a high degree of correlation between belief and experience of remote staring detection, and that on some measures females are more likely to believe in and experience remote staring detection than males. The survey also revealed that as more obstacles or controls are placed between the starer and the staree then people are progressively less likely to believe that remote staring detection can occur. Finally, there was also evidence that there are differences between the levels of belief in the 'evil eye' and the belief in remote staring detection, and although more research examining this difference is required, it suggest that they could represent different belief systems.

The results from the web survey reveal a complexity to the beliefs and experiences of remote staring detection that has not been explored as fully in previous research. The web survey neatly emphasises the importance of remote staring belief and experience to some individuals, and provides further evidence to justify the experimental exploration of this phenomenon.

The initial experiment, reported in Chapter 6, represented the first attempt to examine the electrocortical processing associated with remote staring detection. The experiment found evidence for an overall global effect which initially appeared to be associated with the addition of a remote staring stimulus to the presentation of a face on the staree's computer screen. This effect significantly decreased the peak global processing associated with face processing, and also lowered the level of alpha activity that was associated with the viewing of a face. In addition, this stimulus demonstrated no significant differences from the processing associated with looking at a blank screen.

The second experiment, reported in Chapter 7, examined the effect noticed in the first experiment in further detail by examining the impact of the addition of the 'remote staring detection' stimulus on the processing of both faces and objects. A similar effect to the first experiment was found, but in the opposite direction, with the addition of the 'remote stare' stimulus significantly increasing the peak global processing associated with both faces and with objects, suggesting that the effect was not specifically associated with faces. *Post-hoc* analyses deconstructed this effect further, providing evidence to suggest that the processing associated with the addition of the 'remote stare' mirrored the processing of the visual stimulus that was being presented at the same time, regardless of what the stimulus was. This was evident from an overall global level and even at the localised areas involved in the processing of faces. There was also evidence to suggest that the effect of this additional stimulus was primarily evoked in nature, not induced, and generally involved a wide-band of relatively low frequency activity (approximately 4 to 20Hz).

The third experiment, reported in Chapter 8, attempted to understand the nature of the reversal of the effect between the first two experiments, and if the effect was directly tied to the stimulus of 'remote staring detection'. Using a similar design to the previous experiment, the third experiment found evidence which suggested that although the addition of the 'remote stare' stimulus had a similar effect on the processing of faces as found in the second experiment, there was also an increase in the peak global amplitude of the processing of faces when the starer was removed from the experimental set-up. Although this could represent a unique aspect of remote staring detection, the fact that the processing of the faces in the 'camera-masked' conditions were very similar to one another, and that the processing in the 'camera-unmasked' conditions were also very similar to one another, suggested that further investigation was required in case another effect was responsible for the apparent 'remote staring detection' effect. The photodiode experiment, also reported in Chapter 8, found evidence that suggested that there was a very small luminance difference in the images presented to the staree's computer screen between the 'camera-masked' and the 'camera-unmasked', which occurred very rapidly at the initial presentation of the images. This luminance difference is potentially within the range of human visual detection and may have been responsible for the electrocortical processing differences between the different conditions.

In addition to these primary findings, none of the experiments noted any significant differences in the mean skin conductance levels for each of the different conditions. Also, the questionnaire measures of paranoia and self-consciousness largely did not correlate with the psychophysiolgical measures, apart from some relatively minor correlations in the third experiment.

As can be seen, the results presented in this thesis are complex and can be interpreted in different ways. Because only future empirical research will be able to untangle the potential 'remote staring detection' effect from the possible impact that the luminance differences provide, the results are explored below from their potential impact to the field of psychophysics, and to the field of parapsychology, before leading to an overall discussion of their implications and what future directions this research can be taken in.

9.2 Implications for psychophysics

The photodiode experiment provided evidence suggesting that the effect noted in the third experiment, and possibly the earlier experiments, may have been due to small luminance differences in the images that were presented to the staree. This was apparently associated with the 'masking' or 'unmasking' of the live video feed to the starer's screen resulting in there being slight luminance differences in the images on the staree's screen depending upon the condition. These luminance differences were then processed in such a way to give the impression of an apparent 'remote staring detection' effect.

This processing of luminance differences could have a significant impact in the understanding of psychophysics. The majority of research into basic luminance detection is generally conducted within the context of examining other phenomena, but one of the most directly comparable ERP studies suggested that there were *non-significant* processing of luminance differences down to a difference of over 15 foot-lambert (Johannes et al., 1995). However, the experiment presented in this thesis appeared to suggest evidence of *significant* shifts in the global processing of luminance differences of approximately only 0.7 foot-lambert, and these effects are also relatively consistent. This would suggest that it is possible to gain meaningful and significant ERP differences for smaller luminance differences than previous research has suggested.

This finding potentially has important implications for ERP research in general, and certainly not restricted to just parapsychological research. The image used in the different conditions in the third experiment was the same image file, regardless of condition. The luminance differences detected in the photodiode experiment, and the potential consequence for electrocortical processing, were centred around differences in the presentation of the same image for each condition. This can have consequences for a wide range of ERP studies. It implies that any minor differences in the luminance of an image, even if they are generated due to properties of the hardware or software, could create significant differences in the processing of the images. This is independent of the differences between the content of the images: it is entirely dependent upon any minor differences in luminance. This could imply that many of the processing differences between different stimuli noted in ERP studies are not necessarily due to the characteristics of the stimuli themselves, but instead possibly due to any minor luminance differences between the images.

However, there are issues surrounding the luminance effects noted in the photodiode experiment, and the findings do not necessarily neatly explain all of the effects noted throughout the thesis. The majority of the effects of the 'remote staring' conditions on both the overall GFP and the ERPs of individual channels seem to represent an increase (or decrease) of the peak components, regardless of the visual stimulus that is being processed. For example, in the second experiment the face processing condition demonstrated typical waveform characteristics as noted in the literature. Although this was not notably different from object processing overall (in the GFP analysis, it was in the PLS analysis), it was highly significantly different at the T6 site, which has been noted as being associated specifically with the processing of faces. The waveform of the face processing demonstrated an initial positive component, followed by a negative component that had a far higher amplitude than the object processing condition (i.e., the N170 face processing component as reported in the literature), and then a second positive component at which peaked at around 270ms displayed very different characteristics for the face processing condition than for the object processing condition. The addition of a 'remote stare' to both the face and object processing conditions did not change the characteristics of the waveforms in any drastic manner — the processing characteristics demonstrate similar peak components and latencies. However, this added stimulus appeared to significantly increase the peak processing of the visual stimuli, mapping directly onto the processing, but enhancing the peak activity.

Allison et al. (1999), used trans-cranial electrodes in their research examining key elements of face processing and the processing of other stimuli and present a key finding to this discussion of luminance:

> "The earliest activity evoked in visual cortex is reflected by N100 and P100. This activity is sensitive to elementary stimulus features such as luminance, and is thus distinguishable from category-specific ERPs, which are sensitive to stimuli of a particular category but not to equiluminant stimuli of another category."
>
> (Allison et al., 1999, p. 426)

In contrast to the above findings reported by Allison et al. (1999), the difference in the 'remote staring' conditions appear to have an impact upon components substantially later than 100 milliseconds after stimulus onset, and to mirror the processing of the visual stimulus. Although Allison et al. (1999) had access to far greater spatial resolution thanks to their use of trans-cranial electrodes, the processing in the 'remote staring' conditions appears to mirror the location of the processing of the visual stimulus, at the T6 site which is key in the processing of faces, and not in the V1 area. In addition to this, the effects found by Allison et al. (1999) were produced by showing participants stimuli with a variation in their luminance levels of 4 cd/m^2 for between 250–500ms, but the luminance differences found from the photodiode test suggest that the luminance shift of approximately 2.5 cd/m^2, a far smaller difference than Allison et al.'s (1999) stimuli. This also lasted for only approximately 20ms at the beginning of the presentation of the stimulus, and not during the entire period of stimulus presentation.

This is further complicated by the fact that the first experiment, which used almost exactly the same program and stimuli to the second and third experiments (although there were some equipment changes due to the system upgrade), found the opposite effect to the latter experiments. Although remote staring detection has a history of providing effect-reversals, the impact of luminance differences on processing should be relatively consistent as it is a key element of visual processing.

Interestingly, the luminance of the face stimuli used in McCarthy et al.'s (1999) research on face processing had a variability in the luminance levels of between 4 to 7 cd/m^2. As the luminance differences noted in the photodiode experiment were as low as approximately 2.5 cd/m^2, if the luminance effect is responsible for the results noted throughout the experiments reported in this thesis, then it implies that McCarthy et al.'s (1999) influential findings on face processing might have been due to differences in the luminance levels of the stimuli, and not necessarily due to the processing of faces. This is a prime example of the potential implications of the luminance effect on ERP studies as a whole.

This would suggest that a luminance difference of approximately 2.5 cd/m^2 lasting for approximately 20ms can have a significant impact upon the processing of a stimulus, being demonstrated in the peak amplitudes for over 270ms after stimulus onset. This by no means provides evidence that remote staring detection is definitely having an effect upon the processing of faces and objects, but rather that the luminance differences between the stimuli do not neatly explain the effects noted in this thesis and that there are still issues with this explanation which need to be explored. If the results noted in this thesis are demonstrated as being due to a luminance differences in future work, then they indicate that very small differences in image luminance, which are a key property of a stimulus, can (a) have significant effects upon the processing of an image, (b) effect peak amplitudes at latencies later than previous research has suggested, and (c) can also potentially reverse the effects of processing the same stimuli between experiments. In many respects these findings could potentially be as controversial as evidence of the electrocortical processing of remote staring detection.

Obviously, more research examining the extent of this potential luminance effect is required. By exploring the effect of luminance in more detail it would assist in not only understanding what its implications are for the potential 'remote staring detection' effect, but also what impact such an effect could have on a wide range of ERP studies. If the effect is valid then it offers a substantial challenge to the validity of the apparent 'remote staring detection' effects noted in the different experiments of this thesis, but as the design of the experiments were also very similar to ERP studies conducted throughout psychology and neuroscience, it also brings into question the very nature of visual stimulus presentation in ERP experiments.

9.3 Implications for parapsychology

If future research can eliminate the potential impact of luminance on the effects noted in this thesis, then the results presented here could have implications for parapsychology in general, and research into remote staring detection in particular.

The most significant potential impact of the experimental results from this thesis is quite simply that they would provide evidence that electrocortical processing of remote staring detection is possible, and it is feasible to measure it using EEG methods. However, the results also imply that the potential effect of remote staring detection is a complex one and in itself open to debate and different interpretations. Firstly, the effect does not appear to have any electrocortical processing associated with it when it is administered in isolation. The effect appears to be dependent upon the processing of other stimuli which it can then act upon and significantly modify from the processing associated with these processes on their own. Secondly, there was initial evidence to suggest that the processing associated with the remote staring detection effect might be specifically related to the processing of faces, but subsequent evidence demonstrated that it could also have an impact upon the processing of objects as well. Finally, there was evidence to suggest that the remote starer might not be necessary in order to evoke the 'remote staring detection' effect, but the mere *potential* of being stared at remotely appeared to be enough to significantly change the processing associated with faces.

Of all of the findings reported in the thesis, this final result could potentially have the most substantial implications for parapsychological research. Throughout the remote staring detection literature, the basic assumption is that one person might be able to detect another person staring at them remotely — the very nomenclature reflects this. However, this finding suggests that the potential remote staring detection effect might not necessarily reflect the passive detection of a remote stare on behalf of the staree. Instead it suggests that the staree might actively seek out information in their environment, so that they are aware of even the potential for being stared at, even if there is no remote starer present. This is in direct contrast to Sheldrake's (2005b) *perceptual fields* hypothesis, which developed from his ideas on *morphic fields* (Sheldrake, 1988), where he suggests that the perceptual fields of the starer and the staree somehow interact in order to produce what he refers to as 'the feeling of being stared at'. This is tied into his ideas surrounding extramission as being an explanation of visual perception, but the results from the third experiment suggest that detection does not rely upon any extramission on behalf of the starer, or potentially a starer at all — only for the *potential* of being stared at. Sheldrake (2005b) acknowledges the difficulty in integrating the EDA-CCTV remote staring detection experiments into his perceptual fields hypothesis due to the nature of the equipment and the physical barriers involved, and the findings from the third experiment present even further challenges to this hypothesis.

These results could be indicative of an awareness of the extended environment in which we live. They suggest that the concept of remote staring detection is misleading as it is currently understood and expressed, and that the mere possibility of being stared at remotely is enough to have an impact upon our processing of other stimuli. Perhaps a metaphor for this would be a spider at the centre of its web. The spider can sense its immediate environment very well, but relies upon minute tremors of its web to make it aware of its wider environment. We might be able to process our immediate environment very well, but the processing of our wider environment is expressed as small effects on the processing of other events.

The effects suggested in the third experiment are also challenging when they are considered along with the effects noted in the literature on remote staring detection. Braud et al.'s (1993b) 'sham' condition did not find any significant differences between the no-staring conditions, and the conditions where the participant would have been stared at if a starer had been present. The SC results from the third experiment also failed to find any difference in the mean SC activity of these two conditions, but as there were also no significant SC differences noted between any of the conditions in either the second or third experiments, it is still inconclusive if the SC data collected in this thesis represents a valid measure for the possibility of being stared at remotely. In fact, the lack of significant findings for the SC measures taken during the experiments reported in this thesis do not necessarily provide evidence for or against the previous EDA results presented in the literature. The SC results in this thesis are possibly due to the fact that the methods used were more optimal towards EEG recordings and not towards SC recordings, mainly due to the nature in which the stimuli were presented. Previous remote staring studies using EDA methods have used longer epochs with fewer stimulus administrations, and the nature of the epoch length and number of stimulus administrations used in the experiments presented here, although ideal for EEG methods, may have contributed in the lack of significant differences between the SC responses for the different stimuli.

The results presented in this thesis also have implications for research that has been conducted exploring the 'sender/receiver' relationship in parapsychology. There has been some evidence to suggest that two individuals who have a close personal relationship have a better likelihood of scoring significantly in certain parapsychology studies (Dalton, 1997). However, the findings from the third experiment suggest that a 'sender' is not required at all, and the emphasis is on the so-called 'receiver' (these terms are potentially misleading as the mechanism behind the phenomenon is unknown). Similar findings have been reported from research using the Ganzfeld method, where evidence has been found to suggest that it is the *expectation* on behalf of the 'receiver' that a 'sender' is present that is important, rather than the actual presence or absence of a 'sender' (Roe, Sherwood, & Holt, 2004). As the starees in the third experiment were never informed before the experiment that the presence or absence of the starer was going to be manipulated, they had the expectation that a starer would be present throughout the experiment. These findings imply that the relationship between the pair is irrelevant and the manipulation of the very presence of the 'sender' needs to be explored in greater detail in future research. This may also help to deconstruct the legacy of such terms as 'telepathy', 'precognition', 'psychokinesis' and even 'DMILS' for parapsychology. Although they have been useful in helping to frame the issues under investigation, they have become terms that instil dogmatic thinking that could potentially lead to different phenomena being grouped together when they should not necessarily be, or restrict new ways of thinking about these phenomena that are yet to be fully understood.

Although the EDA-CCTV experiments can be interpreted in terms of the 'possibility' of being stared at, as their very methodology prohibits the possibility of being stared at during the no-stare conditions, the direct-looking experiments do not have this control built in. This means that during the direct-looking experiments it is generally far easier for the starer to look at the staree during the no-stare periods. This implies that the mere possibility of being stared at remotely is continually present during the direct-looking experiments, regardless of the condition, suggesting that there should theoretically be no significant differences in the potential processing of the stimuli. This comparison between the direct-looking method and the EDA-CCTV method, from which the EEG methods were developed, represents a direct challenge to the validity of the 'remote staring detection' effect noted in the third experiment. However, this finding could also emphasise the differences between the direct-looking and the EDA-CCTV methods. Parapsychology is replete with examples of phenomena that have similar characteristics, and yet could have dramatically different causes or mechanisms.[1] As I have argued previously (I. S. Baker, 2005), it is possible that although both types of experiment developed out of anecdotal reports, the direct-looking experiments could be ultimately examining

[1]For example, Tyrrell's (1943/1973) highly influential classification of apparitions makes no direct distinction between apparitions which interact with their environment and the people who are in it, and those which do not. This interactional element could be a key component for understanding the potential causes of such phenomena, and could demonstrate that radically different mechanisms are responsible.

a different phenomenon than the EDA-CCTV experiments (and by association, the EEG-CCTV experiments reported here). Although it is collectively referred to as 'remote staring detection', it is possible that the results noted by both methods are actually caused by different mechanisms and the association is a symptom of the methodological development, but each method is actually 'tapping into' a different phenomena. It is difficult to evaluate this suggestion and only future research comparing both methods may lead to an answer.

The results from the third experiment also preclude a potential DMILS or 'action at a distance' effect (Braud, 2003). Although it is possible that the starer was thinking about the staree during the periods in which the starer was removed from the experiment, the nature of the methodology suggest that this potential effect of 'intent' did not have an impact upon the results. This is because there is no way by which the starer could have been aware of the randomised and counterbalanced sequence of the 'face (starer absent)' and 'face + remote stare (starer absent)' conditions and therefore would not have known at what point to attempt to have a remote effect of intention on the staree and when to not.

However, the extent to which interpretations based upon the results of the third experiment can be applied are limited. First, it represents the findings of a single study and replications testing for the effects of the presence and absence of the remote starer (obviously controlling for any potential luminance effect) are required in order to provide a better understanding of this effect. Secondly, the reversal of the effect from experiment one to the subsequent experiments not only represents a challenge to the luminance effect, but it also challenges the potential 'remote staring detection' effect. Although reversals in the effects of remote staring detection have been previously noted in the literature (e.g., Braud et al., 1993b), further experimentation is required in order to understand why this happened to the GFP results. As has been discussed previously, it is possible that the effect reversal was due to the way that the stimuli were presented in the different experiments, and this is supported to some extent by the fact that the stimulus presentations in the second and third experiment were virtually identical, both producing an increase in global peak amplitudes for the remote staring conditions. This possibility needs to be examined further as it could have implications for a wide range of ERP studies. If the manipulation of the presentation of a stimulus can dictate its global processing, then ERP studies as a whole need to control and carefully report the nature of the stimulus administration. Of course, due to the potential sensitivity of the effects noted in the different experiments to changes in equipment settings, it is possible that this reversal effect may have been due to the minor equipment upgrades between the first and second experiments. However, if this is true then it represents a major and somewhat disturbing challenge to the ERP analysis method in general, as it suggests that any small alterations in equipment set-up can potentially have significant effects on the outcome of an experiment.

The results from all of the studies present yet further questions that need to be explored in future research. As previously discussed, one of the persistent questions in the remote staring detection research is the issue of the *restriction of response*. Braud et al. (1993a) originally introduced the EDA measure as a mechanism by which cognitive interference as represented by higher cortical functions could be avoided. By measuring potential psychophysiological responses to remote staring detection directly, they hoped to provide a less subjective and more accurate and reliable measure of detection. The use of EEG methods continues this line of reasoning, and by measuring electrocortical activity provides a greater wealth of data surrounding the potential processing of the remote staring stimulus. However, the mechanism behind remote staring detection is still unclear, particularly the nature of the response and under what conditions it works. The results presented in this thesis suggest that the potential impact of remote staring detection is very rapid and acts upon the processing of other stimuli. This would imply that this activity is somewhat ubiquitous and virtually every time an individual is stared at remotely, or indeed have the possibility of being stared at remotely, the processing of other stimuli in their environment is affected in some small way. Due to the sheer complexity of our environments and the huge number of times that we could potentially be stared at remotely every day, it is evident that this psychophysiological response does not always result in concious awareness or otherwise we would be on a constant state of alert and hyper-vigilance. If the anecdotal reports are indicative of the electrocortical phenomena noted in the lab, then we would be experiencing this feeling constantly.

Therefore there must be a mechanism which provides a restriction of response. Only under certain conditions does the physiological detection of a remote stare, or potential of a remote stare, result in conscious awareness that may or may not then be acted upon. This suggests that the mechanism involves some kind of 'threshold' effect that allows the information to be 'pushed' into conscious awareness. It might be possible that the emotional content surrounding the remote stare might result in a 'tag' being associated with the stare so that particularly aggressive or amorous stares have a higher probability of reaching conscious awareness than more passive remote stares. This is certainly possible with conventional stares, with evidence from electrocortical studies suggesting that the P200 and N300 ERP components are associated with the identification and processing of emotionally-sensitive stimuli, specifically angry faces, with the P200 component being specifically associated with "valence-tagging" in face processing (Schutter, de Haan, & van Honk, 2004, p. 31). This certainly helps to explain why angry or fearful expressions are processed considerably differently than other facial expressions (see Balconi & Pozzoli, 2003; Batty & Taylor, 2003; Esslen, Pascual-Marqui, Hell, Kochi, & Lehmann, 2004) and are generally detected quicker and more efficiently (Fox et al., 2000). This concept of emotional tagging of remote stares is also further implied by Baron-Cohen's (1995) discussion of an awareness of being watched making sense from an evolutionary perspective as it could represent an early warning system for aggressive stares (p. 98).

One potential way of testing this would be to expose starees to neutral and aggressive faces, both with and without the addition of a neutral remote stare at the same time, to see if the emotional content of the face acts as a 'tag' to the remote stare, possibly altering the nature of the electrocortical processing associated with it. However, as remote staring detection appears to have similar effects to both face and object processing, it is unclear if specific emotional content changes in the face stimuli will definitely have a pronounced effect. An alternative would be to attempt to administer neutral or aggressive remote stares at the same time as a neutral stimulus (such as the emotionally-neutral IAPS picture of a chair) in order to see what effects there are on the processing of the image, and if there is associated conscious awareness. However, such a design would have several methodological challenges. First, it is difficult with the current methodology to have a fully randomised and counterbalanced design and expect the remote starer to be able to convincingly switch between emotional states within a few seconds. It might be possible to overcome this by using a *block-design*, similar to fMRI experiments, where several administrations of a particular stimulus are provided sequentially, and these blocks of stimulus administrations are randomised and counterbalanced collectively. Second, it might be difficult to induce a valid emotional stare in the remote starer on demand, and subjective evaluation of the emotional properties of the intent behind the stare on behalf of the remote starer would be required in order to provide consistency. Finally, if a measure of conscious awareness is required, then possibly the best method is to ask the staree to press a button whenever they feel that they are being stared at remotely. However, such a measure was not included in the experiments reported in this thesis because there is the possibility that preparatory and motor cortex activity and associated muscle response could have produced noise and additional artefacts in the EEG recordings.

It should be noted that the concept of emotional tagging being associated with the restriction of response is also challenged by the findings of the third experiment. If starees are responding to the mere possibility that they could be stared at remotely at any particular time, then there is no remote starer present in order to provide a particular emotionally-laden remote stare. The suggestion is that the response is even more passive than that, which leaves the restriction of response issue unresolved.

The core method used in the experiments presented in this thesis could in itself have important implications for parapsychology. The core method involved examining the potential impact of a parapsychological stimulus on the processing of a more conventional stimulus. By measuring the processing associated with a conventional visual stimulus, it was possible to establish that the method was working correctly, to compare the data from this conventional processing with previous literature, and to establish a valid baseline of activity. By then measuring the effect of administering a parapsychological stimulus at the same time as the conventional stimulus, it was possible to test for any significant deviations from the baseline processing of the conventional stimulus. This is of potential interest to parapsychology as a whole because it could represent the way in which a potentially 'paranormal' stimulus is processed in real-life. It is unlikely that such a stimulus is processed in isolation, instead such a stimulus would be processed alongside other, more 'conventional' stimuli, and have to compete with other processes for resources and for conscious awareness, possibly by the use of emotional tagging as outlined above. This is similar in many respects to Stanford's (1974) model of *Psi-Mediated Instrumental Response (PMIR)*, in that it suggests that both 'psi' and the more conventional senses are used to scan the environment for relevant information, it can involve emotional arousal or physiological response preparation (i.e., an effect measured in the EEG measures), and does not necessarily require conscious awareness. However, the evidence presented here is more suggestive of the possible scanning of the environment, as suggested by the early stages of the PMIR model, and the evidence does not necessarily extend to the progression of an 'instrumental response', as environmental awareness could be the goal in itself.

With regards to the method, by examining the processing of a 'conventional' stimulus, and the processing of a 'conventional' and a potentially 'paranormal' stimulus simultaneously, it is possible to not only examine how such processing might occur in real-life, but the 'conventional' processing provides a clearly defined baseline of activity from which the processing of the additional 'paranormal' stimulus might deviate from. In many respects this is the reverse of the influential *noise reduction model* (Honorton, 1977, 1978; Braud, 1978b), where it is suggested that parapsychology experiments should be attempting to minimise external and internal noise in order to allow the individual to focus upon their own mentation. Instead, this is suggesting that we take an ordinary process which is relatively well understood and see if the addition of a 'paranormal' stimulus has any significant impact upon this baseline processing — in many respect adding controlled 'noise' to the system. In some respects this is similar to Stevens's (2000) model of using the principle of *stochastic resonance*, where instead of attempting to remove the noise from a system, the presence of the noise in the system provides enough extra energy in order to 'boost' the signal of a potentially 'paranormal' process, except in this case the 'noise' is a controlled, discrete stimulus of which the processing is relatively well recorded. This method could be employed in other areas of parapsychology, particularly with the use of EEG methods. For example, by using this method it might be possible to examine the effects of the reinforcement of the processing of a particular stimulus by a remote individual, or how conventional, pre-cognitive and remotely reinforced processing interact.

The results from the SCS and paranoia questionnaires for all three experiments suggest that the different measures of self-consciousness and paranoia have little significant relationship to the psychophysiological measures of remote staring detection. Although it is possible that this is because the SCS and paranoia measures simply do not correlate with remote staring detection, it might also be because the number of participants in each experiment was relatively low for questionnaire measures and therefore the required power was not achieved. There is also the complex conceptual issue surrounding how small differences in the electrocortical activity associated with the processing of two different stimuli correspond with more abstract measures of personality factors. A potential way for future research to address this would be to replicate the remote staring detection survey, but to also add the SCS and paranoia questionnaires in order to see the potential correlations between these personality factors and the belief in and experience of remote staring detection. This method would also provide a far higher number of participants with a more widespread distribution of responses than an psychophysiology experiment could hope to obtain, and could uncover evidence of whether or not more paranoid or self-conscious individuals report higher incidences of belief or experience of remote staring detection.

Finally, in addition to the above implications the findings from all of the experiments, and particularly the third experiment, provide an interesting potential implication for social policy. The findings from the experiments suggest that remote staring detection, and even just the potential of being stared at remotely, has a significant effect on the electrocortical processing of other stimuli. The United Kingdom is currently going through an enormous rise in the number of surveillance systems, particularly CCTV systems, that are being established throughout the country (Norris & Armstrong, 1999). As I have noted in previous work (I. S. Baker, 2005), it was estimated in 2003 that there could be as many as 4.2 million CCTV cameras in the U.K., which translates as one camera for every 14 people (McCahill & Norris, 2003, as cited by Norris et al., 2004). Therefore this high possibility of being stared at remotely on a daily basis may be having a continual effect upon the electrocortical processing of people in their everyday lives, which in turn may have an impact upon people's behaviour on a virtually continual basis.

9.4 Final discussion comments

The results presented in this thesis are open to different interpretations. On one hand it is possible to view them as evidence for the electrocortical processing of remote staring detection. On the other hand they demonstrate previously unknown characteristics of the electrocortical processing of very small and rapid luminance differences between different visual stimuli.

The potential interpretation of the results as an effect of 'remote staring detection' are enlightening, as they would provide evidence and understanding of a phenomenon that relatively little is known about. Although the first piece of research examining this phenomenon was reported over 100 years ago, these experiments could potentially represent the first piece of research to explore the potential processing of this phenomenon using measures of brain activity. Such findings would be very revealing as they would demonstrate several features that were previously unknown in parapsychology: that electrocortical processing of 'remote staring detection' has to act upon other processes, that it appears to act upon the processing of different visual stimuli, and that a remote starer is not necessarily required *per se*, just the mere possibility of being stared at remotely would appear to be enough to significantly change the processing of a visual stimulus.

However, such an interpretation is challenged considerably by the alternative explanation: that the differences in electrocortical processing between those conditions with the addition of a 'remote stare' and those without were due to very small and rapid luminance differences at the presentation onset of the visual stimuli. This is supported by the fact that in the third experiment the activity associated with face processing when there was and was not a remote starer present (in the 'camera-unmasked' conditions) was almost identical. Of course, the strongest evidence for this finding was the differences between the luminance levels of the images in both conditions as found by the photodiode experiment.

But this explanation also has its problems. Although there has been relatively little experimental research examining the electrocortical processing of very small and rapid luminance differences, what research has been conducted presents a considerably different picture of how luminance differences are processed by the brain. This means that this finding could potentially have implications for the understanding of the processing of luminance differences and for how ERP studies are conducted in general.

It is, of course, possible that the results presented in the thesis are due to a combination of these two interpretations. Although this is not particularly parsimonious, it can only be eliminated as a possible explanation by further research.

9.4.1 Future directions

Possible avenues for future research have been discussed throughout the thesis, but several specific directions for how this empirical research can be continued are outlined below.

Obviously, there are two main potential research streams to stem from the research presented in this thesis. The first of these research streams involves a closer examination of the possible electrocortical processing of remote staring detection, controlling for any potential luminance differences. In many respects this research could follow the research presented in the three main experiments in this thesis. It is necessary to establish, (a) if remote staring detection has processing associated with it in its own right, (b) if it impacts upon the processing of visual stimuli, (c) if it has a specific association with face processing, and (d) if the mere possibility of a remote stare is enough to have an impact upon the processing of other stimuli. Associated with this is an exploration of how rapid the processing associated with remote staring detection might be: is it a slow, gradual build-up, or a rapid change?

This line of research can then be opened-up to better understand the issue surrounding the restriction of response, and if emotional content associated with the remote stare evokes changes in the processing associated with it and potentially leads to a higher probability of becoming consciously aware of it. Also, it is vital that future research examines if the EDA-CCTV or EEG-CCTV studies represent the measurement of a different phenomenon to that examined by the direct-looking experiments.

The second line of research involves examining the effects of image luminance on visual image processing in general. These experiments need to present participants with subtly different levels of luminance changes in the same image, and also using different durations of luminance changes at stimulus onset. This would have its own methodological challenges as the precise measurement of luminance is difficult. However, such a method would provide an assessment of the impact of the luminance differences, as measured in the photodiode experiment, on electrocortical processing.

This would also inform psychophysics regarding the sensitivity and effects of small and rapid luminance differences, and help to improve ERP methods and to minimise the chances that notable effects from ERP studies are due to small luminance differences between the different stimuli.

Finally, the web survey on the experiences and belief surrounding remote staring detection can be expanded by the addition of other personality measures, such as self-consciousness and paranoia, to present an ever-increasing picture of the types of people who are more likely to believe in and report remote staring detection experiences. This may help in pre-selecting participants for future experiments in order to compare groups that could be high or low in terms of their potential susceptibility to remote staring detection.

9.5 Final conclusions

The central issue surrounding the experimental findings of this thesis is that any information in a parapsychology experiment that can provide the participant with information concerning the nature of what condition they are in at any particular time invalidates the primary aim of the experiment: to find evidence of awareness or communication beyond the range of the conventional senses. In this case the mere possibility of the luminance effect providing condition-relevant information that could be processed by the participant undermines any claims of a remote staring detection effect. However, the luminance effect in itself is anomalous in its nature because it has implications that luminance shifts themselves are potentially being processed in ways that have not been previously revealed. This potential luminance effect challenges the current understanding of electrocortical processing and could have significant implications for the manner in which ERP studies are conducted and the conclusions that can be drawn from previous ERP work performed in all fields of research. Only further research following both of these primary research paths can unravel the full extent of the findings of this thesis.

References

Ahrens, R. (1954). Beitrag zur entwicklung des physiognomie und-mimikerkennens. *Z. exp. Psychol.*, *2*, 412-454.

Alexander, C. H. (2002). Psychic phenomena and the brain: An evolution of research, technology, and understanding. In C. Watt (Ed.), *Proceedings of the Parapsychological Association 45th Annual Convention* (p. 9-24). New York: The Parapsychology Association.

Allen, J. J. B., Coan, J. A., & Nazarian, M. (2004). Issues and assumptions on the road from raw signals to metrics of frontal EEG asymmetry in emotion. *Biological Psychology*, *67*, 183-218.

Allison, T., Puce, A., & McCarthy, G. (2000). Social perception from visual cues: Role of the STS region. *Trends in Cognitive Sciences*, *4*(7), 267-278.

Allison, T., Puce, A., Spencer, D. D., & McCarthy, G. (1999). Electrophysiological studies of human face perception I: Potentials generated in occipitotemporal cortex by face and non-face stimuli. *Cerebral Cortex*, *9*(5), 415-430.

Argyle, M. (1988). *Bodily Communication* (2nd ed.). London: Routledge.

Argyle, M. (2001). *Personal communication.*

Argyle, M., & Cook, M. (1976). *Gaze and Mutual Gaze.* UK: Cambridge University Press.

Argyle, M., & Williams, M. (1969). Observer or observed? A reversible perspective in person perception. *Sociometry*, *32*, 396-412.

Atkinson, A. P. (2005). Staring at the back of someone's head is no signal, and the sense of being stared at is no sense [peer commentary on 'the sense of being stared at']. *Journal of Consciousness Studies*, *12*(6), 50-56.

Bahr, G. S. (2003). Comment: Psychologists' belief in visual emission. *American Psychologist*, *58*(6/7), 494.

Baker, I. S. (2001). *The relationship of gaze-avodiance to shyness and belief in the power of gaze, and an analysis of vocabulary for eye-fixation research.* (Unpublished Masters thesis, The University of Edinburgh, Scotland.)

Baker, I. S. (2005). Nomenclature and methodology [peer commentary on 'the sense of being stared at']. *Journal of Consciousness Studies, 12*(6), 56-63.

Baker, R. A. (2000). Can we tell when someone is staring at us? *Skeptical Inquirer,*(March/April), 34-40.

Baker, R. A. (2001). Robert Baker replies to Sheldrake. *Skeptical Inquirer,*(March/April), 61.

Balconi, M., & Pozzoli, U. (2003). Face-selective processing and the effect of pleasant and unplesant emotional stimuli on ERP correlates. *International Journal of Psychophysiology, 49*, 67-74.

Baron-Cohen, S. (1994). How to build a baby that can read minds: Cognitive mechanisms in mindreading. *Cahiers de Psychologie Cognitive, 13*, 513-552.

Baron-Cohen, S. (1995). *Mindblindness: An Essay on Autism and Theory of Mind.* Massachusetts: The MIT Press.

Batki, A., Baron-Cohen, S., Wheelwright, S., Connellan, J., & Ahuluwalia, J. (2000). Is there an innate gaze module? Evidence from human neonates. *Infant Behaviour and Development, 23*, 223-229.

Batty, M., & Taylor, M. J. (2003). Early processing of the six basic facial emotional expressions. *Cognitive Brain Research, 17*, 613-620.

Becker, L. A. (1999). *Effect size calculators.* Retrived on the 13th August 2005 from http://web.uccs.edu/lbecker/Psy590/escalc3.htm.

Beloff, J. (1974). ESP: The search for a physiological index. *Journal of the Society for Psychical Research, 47*(761), 403-417.

Bentin, S., Allison, T., Puce, A., Perez, E., & McCarthy, G. (1996). Electrophysiological studies of face perception in humans. *Journal of Cognitive Neuroscience, 8*(6), 551-565.

Bentin, S., & Carmel, D. (2002). Accounts for the N170 face-effect: A reply to Rossion, Curran, & Gauthier. *Cognition, 85*, 197-202.

Berger, H. (1929-1938/1969). *On the Electroencephalogram of Man: The Fourteen Original Reports on the Human Electroencephalogram.* (P. Gloor, Trans.). London: Elsevier.

Berger, H. (1940). *Psyche.* Jena: Gustav Fischer.

Blackmore, S. (2005). Confusion worse confounded [peer commentary on 'the sense of being stared at']. *Journal of Consciousness Studies, 12*(6), 64-65.

Bland, J. M., & Altman, D. G. (1995). Statistic notes — Multiple significance tests: The Bonferroni method. *British Medical Journal, 310*, 170.

Bouscein, W. (1992). *Electrodermal activity.* New York: Plenum Press.

Braud, W. (1978). Allobiofeedback: Immediate feedback for a psychokinetic influence upon another person's physiology. In W. G. Roll (Ed.), *Research in Parapsychology 1977* (p. 123-134). Metuchen, NJ: Scarecrow Press.

Braud, W. (1978b). Psi conducive conditions: Explorations and interpretations. In B. Shapin & L. Coly (Eds.), *Psi and States of Awareness* (p. 1-41). New York: Parapsychology Foundation.

Braud, W. (1993, October 29-30). On the use of living target systems in distant mental influence research. In L. Coly & J. D. S. McMahon (Eds.), *Psi Research Methodology: A Re-Examination — Proceedings of an International Conference held in Chapel Hill, North Carolina, October 29-30, 1988* (p. 149-189). US: New York: New York: The Parapsychology Association.

Braud, W. (2003). *Distant Mental Influence: Its Contributions to Science, Healing, and Human Interations.* VA: Hampton Roads, Inc.

Braud, W. (2005). The sense of being stared at: Fictional, physical, perceptual, or attentional/intentional [peer commentary on 'the sense of being stared at']. *Journal of Consciousness Studies, 12*(6), 66-71.

Braud, W., & Schlitz, M. (1983). Psychokinetic influence on electrodermal activity. *Journal of Parapsychology, 47*, 95-119.

Braud, W., & Schlitz, M. J. (1991). Consciousness interactions with remote biological systems: Anomalous intentionality effects. *Subtle Energies, 2*(1), 1-46.

Braud, W., Shafer, D., & Andrews, S. (1993a). Reactions to an unseen gaze (remote attention): A review, with new data on autonomic staring detection. *Journal of Parapsychology, 57*, 373-390.

Braud, W., Shafer, D., & Andrews, S. (1993b). Further studies of autonomic detection of remote staring: Replication, new control procedures, and personality correlates. *Journal of Parapsychology, 57*, 391-409.

Bruce, V., & Young, A. (1986). Understanding face recognition. *British Journal of Psychology, 77*, 305-327.

Burnkrant, R. E., & Page, T. J. (1984). A modification of the Fenigstein, Scheier, and Buss self-consciousness scales. *Journal of Personality Assessment, 48*(6), 629-637.

Cacioppo, J. T., Rourke, P. A., Marshall-Goodell, B. S., Tassinary, L. G., & Baron, R. S. (1990). Rudimentary physiological effects of mere observation. *Psychophysiology, 27*(2), 177-186.

Campbell, R. (1990). Sensitivity to eye gaze in prosopagnosic patients and monkeys with superior temporal sulcus ablation. *Neuropsychologica, 28*, 1123-1142.

Carmel, D., & Bentin, S. (2002). Domain specificity versus expertise: Factors influencing distinct processing of faces. *Cognition, 83*, 1-29.

Carpenter, R. H. S. (2005). Does scopesthesia imply extramission? [peer commentary on 'the sense of being stared at']. *Journal of Consciousness Studies, 12*(6), 76-78.

Chaparro, A., Stromeyer, C. F., & Eskew, R. T. (1994). Separable red-green and luminance detectors for small flashes. *Vision Research, 34*(6), 721-762.

Charman, R. A. (2006). Has direct brain to brain communication been demonstrated by electroencephalograhic monitoring of paried or group subjects? *Journal of the Society for Psychical Research, 70.1*(882), 1-24.

Clarke, C. (2005). The sense of being stared at: Its relevance to the physics of consciousness [peer commentary on 'the sense of being stared at']. *Journal of Consciousness Studies, 12*(6), 78-82.

Coles, M. G. H., Gratton, G., & Fabiani, M. (1990). Event-related brain potentials. In J. T. Cacioppo & L. G. Tassinary (Eds.), *Principles of Psychophysiology: Physical, Social and Inferential Elements* (p. 413-455). Cambridge University Press.

Colwell, J., Schröder, S., & Sladen, D. (2000). The ability to detect unseen staring: A literature review and empirical tests. *British Journal of Psychology, 91*, 71-85.

Compton, R. (2002). Inter-hemispheric interaction facilitates face processing. *Neuropsychologia, 40*, 2409-2419.

Coover, J. E. (1913). The feeling of being stared at. *American Journal of Psychology, 24*, 571-575.

Cottrell, J. E., Winer, G. A., & Smith, M. C. (1996). Beliefs of children and adults about feeling stares of unseen others. *Developmental Psychology, 32*, 50-61.

Critchley, H. D. (2002). Electrodermal responses: What happens in the brain. *The Neuroscientist, 8*(2), 132-142.

Croft, R. J., & Barry, R. J. (2000). Removal of ocular artifact from the EEG: A review. *Clinical Neurophysiology, 30*, 5-19.

Dalton, K. (1997). Is there a formula to success in the ganzfeld? Observations on predictors of psi-ganzfeld performance. *European Journal of Parapsychology, 13*, 71-82.

Davidson, R. J., Jackson, D. C., & Larson, C. L. (2000). Human electroencephalography. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *Handbook of Psychophysiology* (p. 27-84). Cambridge

University Press.

Dawson, M. E., Schell, A. M., & Filion, D. L. (1990). The electrodermal system. In J. T. Cacioppo & L. G. Tassinary (Eds.), *Principles of Psychophysiology: Physical, Social and Inferential Elements* (p. 295-324). Cambridge University Press.

Don, N. S., McDonough, B. E., & Warren, C. A. (1998). Event-related brain potential (ERP) indicators of unconscious psi: A replication using subjects unselected for psi. *Journal of Parapsychology, 62*, 127-145.

Dundes, A. (Ed.). (1992). *The Evil Eye: A Casebook.* Madison: University of Wisconsin Press.

Eimer, M. (2000). Attentional modulations of event-related brain potentials sensitive to faces. *Cognitive Neuropsychology, 17*(1/2/3), 103-116.

Ellis, R. (2005). The ambiguity of 'in here/out there' talk: In what sense is perception 'out in the world'? [peer commentary on 'the sense of being stared at']. *Journal of Consciousness Studies, 12*(6), 82-87.

Ellsworth, P. C., Carlsmith, J. M., & Henson, A. (1972). The stare as a stimulus to flight in human subjects: A series of field experiments. *Journal of Personality and Social Psychology, 21*, 302-311.

Esslen, M., Pascual-Marqui, R. D., Hell, D., Kochi, K., & Lehmann, D. (2004). Brain areas and time course of emotional processing. *NeuroImage, 21*, 1189-1203.

Fabiani, M., Gratton, G., & Coles, M. G. H. (2000). Event-related brain potentials: Methods, theory, and applications. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *Handbook of Psychophysiology* (p. 53-84). Cambridge: Cambridge University Press.

Farroni, T., Csibra, G., Simion, F., & Johnson, M. H. (2002). Eye contact detection in humans from birth. *Proceedings of the National Academy of Sciences of the United States of America, 99*(14), 9602-9505.

Fenigstein, A., Scheier, M. F., & Buss, A. H. (1975). Public and private self-consciousness: Assessment and theory. *Journal of Clinical and Consulting Psychology, 43*, 522-527.

Fenigstein, A., & Vanable, P. A. (1992). Paranoia and self-consciousness. *Journal of Personality and Social Psychology, 62*(1), 129-138.

Ferree, T. C., Luu, P., Russell, G. S., & Tucker, D. M. (2001). Scalp electrode impedance, infection risk and EEG data quality. *Clinical Neurophysiology, 112*(3), 536-544.

Fisch, B. J. (1999). *Fisch and Spehlmann's EEG Primer: Basic Principles of*

Digital and Analog EEG (3rd ed.). London: Elsevier.

Fowles, D. C., Christie, M. J., Edelberg, R., Grings, W. W., Lykken, D. T., & Venables, P. H. (1981). Committee report: Publication recommendations for electrodermal measurements. *Psychophysiology, 18*, 232-239.

Fox, E., Lester, V., Russo, R., Bowles, R. J., Pichler, A., & Dutton, K. (2000). Facial expressions of emotion: Are angry faces detected more efficiently? *Cognition and Emotion, 14*(1), 61-92.

Ginzberg, R. (1949). Three years with Hans Berger: A contribution to his biography. *Journal of the History of Medicine and Allied Sciences*, 361-371.

Gloor, P. (1969). Hans Berger and the Discovery of the Electroencephalogram. In H. Berger (Ed.), *On the Electroencephalogram of Man: The Fourteen Original Reports on the Human Electroencephalogram* (p. 1-36). London: Elsevier.

Gowdy, P. D., Stromeyer, C. F., & Kronauer, R. E. (1999). Facilitation between the luminance and red-green detection mechanisms: Enhancing contrast differences across edges. *Vision Research, 39*(24), 4098-4112.

Gregg, V. R., Winer, G. A., Cottrell, J. E., Hedman, K. E., & Fournier, J. S. (2001). The persistence of a misconception about vision after educational interventions. *Psychonomic Bulletin & Review, 8*(3), 688-626.

Grinberg-Zylberbaum, J., Delaflor, M., Attie, L., & Goswami, A. (1994). The Einstein-Podolsky-Rosen paradox in the brain: The transferred potential. *Physics Essays*, 7(4), 422-428.

Grinberg-Zylberbaum, J., Delaflor, M., Sanchez-Arellano, M. E., Guevara, M. A., & Perez, M. (1992). Human communication and the electrophysiological activity of the brain. *Subtle Energies, 3*(3), 25-42.

Hartwell, J. W. (1978). Contingent negative variation as an index of precognitive variation. *European Journal of Parapsychology, 2*, 83-103.

Henson, R. N., Goshen-Gottstein, Y., Ganel, T., Otten, L. J., Quayle, A., & Rugg, M. D. (2003). Electrophysiological and haemodynamic correlates of face perception, recognition and priming. *Cerebral Cortex, 13*, 793-805.

Heywood, C. A., & Cowey, A. (1992). The role of the "face-cell" area in the discrimination and recognition of faces by monkeys. *Philosophical Transcriptions of the Royal Society of London, 335*, 31-38.

Hodgson, R. (1899). Messrs. Hansen and Lehmann on the telepathic problem. *Journal of the Society for Psychical Research, 9*(162), 113-120.

Honorton, C. (1977). Psi and internal attention states. In B. B. Wolman (Ed.), *Handbook of Parapsychology* (p. 435-472). New York: Van Nostrand

Reinhold.

Honorton, C. (1978). Psi and internal attentional states: Information retrieval in the ganzfeld. In B. Shapin & L. Coly (Eds.), *Psi and States of Awareness: Proceedings of an International Conference held in Paris, France, August 1977* (p. 79-90). New York: Parapsychology Foundation, Inc.

Howell, D. C. (1997). *Statistical Methods for Psychology* (4th ed.). London: Duxbury Press.

Hyman, R., & Honorton, C. (1986). A joint communiqué: The psi ganzfled controversy. *Journal of Parapsychology, 50*, 350-364.

Itier, R. J. (2004, September). *Personal communication.*

Itier, R. J., & Taylor, M. J. (2004). N170 or N1? Spatiotemporal differences between object and face processing using ERPs. *Cerebral Cortex, 14*(2), 132-142.

Itier, R. J., Taylor, M. J., & Lobaugh, N. J. (2004). Spatiotemporal analysis of event-related potentials to upright, inverted, and contrast-reversed faces: Effects on encoding and recogniton. *Psychophysiology, 41*, 643-653.

James, W. (1898). Discussion and correspondence: Lehman and Hansen 'On the Telepathic Problem'. *Science, 8*(209), 956.

James, W. (1899a, May). Discussion and correspondence: Messrs. Lehmann and Hansen on telepathy. *Science, 9*(277), 654-655.

James, W. (1899b). Discussion and correspondence: Telepathy once more. *Science, 9*(230), 752-753.

Jasper, H. (1958). The ten-twenty electrode system of the international federation. *Electroencephalography and Clinical Neurophysiology, 10*, 371-375.

Jasper, H., & Andrews, H. (1938). Electroencephalography III: Normal differentiation of occipital and precentral regions in man. *Archives of Psychiatry, 39*, 96-115.

Jennings, J. R., & Wood, C. C. (1976). The epsilon-adjusted procedure for repeated measures analysis of variance. *Psychophysiology, 13*, 277-278.

Johannes, S., Münte, T. F., Heinze, H. J., & Mangun, G. R. (1995). Luminance and spatial attention effects on early visual processing. *Cognitive Brain Research, 2*, 189-205.

Joyce, C., & Rossion, B. (2005). The face-sensitive N170 and VPP components manifest the same brain processes: The effect of reference electrode site. *Clinical Neurophysiology, 116*, 2613-2631.

Kalcher, J., & Pfurtscheller, G. (1995). Discrimination between phase-locked and non-phase-locked event-related EEG activity. *Electroencephalography and Clinical Neurophysiology, 94*, 381-384.

Kanwisher, N. (2000). Domain specificity in face perception. *Nature Neuroscience, 3*(8), 759-763.

Keppel, G. (1982). *Design and Analysis: A Researcher's Handbook* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Kirkland, J. (1976). [A review of] Gaze and Mutual Gaze by M. Argyle and M. Cook. *British Journal of Psychology, 3*, 371.

Kirkland, J., & Lewis, C. (1976). Glance, look, gaze, and stare: A volcabulary for eye-fixation research. *Perceptual and Motor Skills, 43*(3), 1278.

Kittenis, M., Caryl, P. G., & Stevens, P. (2004). Distant psychophysiological interaction effects between related and unrelated participants. In S. Schmidt (Ed.), *Proceedings of the 47th Parapsychology Association Convention* (p. 67-76). New York: The Parapsychological Association.

Kleinke, C. L. (1986). Gaze and eye contact — a research review. *Psychological Bulletin, 100*, 78-100.

Klimesch, W., Doppelmayr, M., Röhm, D., Pöllhuber, D., & Stadler, W. (2000). Simultaneous desynchronization and synchronization of different alpha responses in the human electroencephalogram: A neglected paradox? *Neuroscience Letters, 284*, 97-100.

Klimesch, W., Russegger, H., Doppelmayr, M., & Pachinger, T. (1998). A method for the calculation of induced band power: Implications for the significance of brain osscillations. *Electroencephalography and Clinical Neurophysiology, 108*, 123-130.

Kobayashi, H., & Kohshima, S. (1997). Unique morphology of the human eye. *Nature, 387*, 767-768.

Kolb, H., Fernandez, E., & Nelson, R. (2005). *Webvision: The organisation of the retina and the visual system.* Retrived on 15th Ocotober 2005 from http://webvision.med.utah.edu/light_dark.html.

Langton, S. R. H., Watt, R. J., & Bruce, V. (2000). Do the eyes have it? Cues to the direction of social attention. *Trends in Cognitive Sciences, 4*(2), 50-59.

Leavitt, L. A., & Donovan, W. L. (1979). Percieved infant temperament, locus of control, and maternal physiological response to infant gaze. *Journal of Research in Personality, 13*, 267-278.

Lehmann, D. (2004). *Personal communication.*

Lehmann, D., & Skrandies, W. (1980). Reference-free identification of components of checkerboard-evoked multichannel potential fields. *Elec-*

troencephalography and Clinical Neurophysiology(48), 609-621.

Lobach, E., & Bierman, D. J. (2004). The invisible gaze: Three attempts to replicate Sheldrake's staring effects. In S. Schmidt (Ed.), *Proceedings of the 47th Parapsychology Association Convention* (p. 77-89). New York: The Parapsychology Association.

Lobaugh, N. J., West, R., & McIntosh, A. R. (2001). Spatiotemporal analysis of experimental differences in event-related potential data with partial least squares. *Psychophysiology, 38*, 517-530.

Luck, S. J., Hillyard, S. A., Mouloua, M., Woldorff, M. G., Clark, V. P., & Hawkins, H. L. (1994). Effects of spatial cueing on luminance detectability: Psychophysical and electrophysiological evidence for early selection. *Journal of Experimental Psychology: Human Perception and Performance, 20*(4), 887-904.

Lykken, D. T., & Venables, P. H. (1971). Direct measurement of skin conductance: A proposal for standardization. *Psychophysiology, 8*, 656-672.

Maloney, C. (1976). *The Evil Eye.* New York: Columbia University Press.

Marks, D. F., & Colwell, J. (2000). The psychic staring effect: An artifact of pseudo randomization. *Skeptical Inquirer,*(September/October), 41-49.

Marks, D. F., & Colwell, J. (2001). Fooling and falling into the feeling of being stared at. *Skeptical Inquirer,*(March/April), 62-63.

Mavromatis, A. (1991). *Hypnagogia: Unique State of Consciousness Between Wakefulness and Sleep.* London: Routledge.

May, E. C., Spottiswoode, S. J. P., & Faith, L. V. (2001). A methodological issue in the study of correlation between psychophysiological variables. In C. S. Alvarado (Ed.), *Proceedings of the 44th Parapsychology Association Convention* (p. 166-178). New York: The Parapsychology Association.

McBride, G., King, M. G., & James, J. W. (1965). Social proximity effects on galvanic skin response in adult humans. *The Journal of Psychology, 61*, 153-157.

McCahill, M., & Norris, C. (2003). Estimating the extent, sophistication and legality of CCTV in London. In M. Gill (Ed.), *CCTV.* Perpetuity Press.

McCarthy, G., Puce, A., Belger, A., & Allison, T. (1999). Electrophysiological studies of human face perception II: Response properties of face-specific potentials generated in occipitotemporal cortex. *Cerebral Cortex, 9*(5), 431-444.

McDonough, B. E., Don, N. S., & Warren, C. A. (2002). Differential event-related potentials to target and decoys in a guessing task. *Journal of Scientific*

Exploration, 16(2), 187-206.

McIntosh, A. R., Bookstein, F. L., Haxby, J. V., & Grady, C. L. (1996). Spatial pattern analysis of functional brain images using partial least squares. *NeuroImage, 3*, 143-157.

McIntosh, A. R., & Lobaugh, N. J. (2004). Partial least squares analysis of neuroimaging data: Applications and advances. *NeuroImage, 23*, S250-S263.

Millar, B. (1979). Physiological detectors of psi. *European Journal of Parapsychology, 2*(4), 456-478.

Millar, B. (1979b). The "Lloyd" effect. *European Journal of Parapsychology, 2*, 381-395.

Millett, D. (2001). Hans Berger: From psychic energy to the EEG. *Perspectives in Biology and Medicine, 44*(4), 522-542.

Mittal, B., & Balasubramanian, S. K. (1987). Testing the dimensionality of the self-consciousness scales. *Journal of Personality Assessment, 51*(1), 53-68.

Morris, R. L. (1977). Parapsychology, Biology, and ANPSI. In B. B. Wolman (Ed.), *Handbook of Parapsychology*. London: McFarland & Company, Inc.

Motagu, J. D. (1963). Habituation of the psycho-galvanic reflex during serial tests. *Journal of Psychosomatic Research, 7*, 199-214.

Mullen, K. T., & Losada, A. (1994). Evidence for sperate pathways for color and luminance detection mechanisms. *Journal of the Optical Society of America A: Optics, Image Science and Vision, 11*(12), 3136-3151.

Neuroscan. (2003a). *NuAmps: Users Guide*. Neuroscan, Compumedics: USA, TX.

Neuroscan. (2003b). *Scan 4.3 — Vol. II: Edit 4.3: Offline Analysis of Aquired Data*. Neuroscan Compumedics Ltd.

Neuroscan. (2005). *NuAmps: Portable 40 Channel Digital DC EEG Amplifier [Technical Specifications]* (Tech. Rep.). Neuroscan Compumedics Ltd.

Neuroscan. (2006). *SynAmps2: White Paper* (Tech. Rep.). Neuroscan Compumedics Ltd.

Nichols, K. A., & Champness, B. G. (1971). Eye gaze and the GSR. *Journal of Experimental Social Psychology, 7*, 623-626.

Norris, C., & Armstrong, G. (1999). *The Maximum Surveillance Society: The Rise of CCTV*. Oxford, U.K: Berg.

Norris, C., McCahill, M., & Wood, D. (2004). The growth of CCTV: A global perspective on the international diffusion of video surveillance in publicly accessible space. *Surveillance and Society, 2/3*, 110-135.

Nunez, P. (1981). *Electric Fields of the Brain: The Neurophysics of EEG.* New York: Oxford University Press.

Nunez, P., & Srinivasan, R. (2006). *Electric Fields of the Brain: The Neurophysics of EEG* (2nd, Ed.). New York: Oxford University Press.

Nuwer, M. R., Comi, C., Emerson, R., Fuglsang-Frederiksen, A., Guérit, J., Hinrichs, H., et al. (1998). IFCN standards for digitial recording of clinical EEG. *Electroencephalography and Clinical Neurophysiology, 106*, 259-261.

O'Keefe, D. J. (2003). Colloquy: Should familywise alpha be adjusted? Against familywise alpha adjustment. *Human Communication Research, 29*(3), 431-447.

Palmer, J. (1997). The challenge of experimenter psi. *European Journal of Parapsychology, 13*, 110-125.

Palmer, S. E. (1999). *Vision Science: Photons to Phenomenology.* Cambridge, Massachusetts: Massachusetts Institute of Technology.

Peli, E., Yang, J., Goldstein, R., & Reevesi, A. (1991). Effect of luminance on suprathreshold contrast perception. *Journal of the Optical Society of America, 8*(8), 1352-1359.

Perrett, D. I., & Emery, N. J. (1994). Understanding the intentions of others from visual signals: Neurophysiological evidence. *Cahiers de Psychologie Cognitive, 13*, 683-694.

Perrett, D. I., Hietanen, J. K., Oram, M. W., & Benson, P. J. (1992). Organization and functions of cells responsive to faces in the temporal cortex. *Philosophical Transcriptions of the Royal Society of London, 335*, 23-30.

Perrett, D. I., Mistlin, A. J., Chitty, A. J., Harries, M., Newcombe, F., & de Hann, E. (1988). Neuronal mechanisms of face perception and their pathology. In C. Kennard & F. Clifford-Rose (Eds.), *Physiological Aspects of Clinical Neuro-Opthalmology* (p. 137-154). London: Chapman & Hall.

Peterson, D. (1978). *Through the looking glass: An investigation of the faculty of extra-sensory detection of being stared at.* (Unpublished Masters thesis, The University of Edinburgh, Scotland.)

Pfurtscheller, G., & Lopes da Silva, F. H. (1999). Event-related EEG/MEG synchronization and desynchronization: Basic principles. *Clinical Neurophysiology, 110*, 1842-1857.

Picton, T. W., Bentin, S., Berg, P., Donchin, E., Hillyard, S. A., R. Johnson, J., et al. (2000). Committee report: Guidelines for using human event-related potentials to study cognition: Recording standards and publication criteria.

Psychophysiology, 37, 127-152.

Pivik, R. T., Broughton, R. J., Coppola, R., Davidson, R. J., Fox, N., & Nuwer, M. R. (1993). Guidelines for the recordings and quantitative analysis of electroencephalographic activity in research contexts. *Psychophysiology, 30*, 547-558.

Plainis, S., & Murray, I. J. (2000). Neurophysiological interpretation of human visual reaction times: Effect of contrast, spatial frequency and luminance. *Neuropsychologica, 38*, 1555-1564.

Poortman, J. J. (1959). The feeling of being stared at. *Journal of the Society for Psychical Research, 40*(699), 4-12.

Porges, S. W., & Bohrer, R. E. (1990). The analysis of perodic processes in psychophysiological research. In J. T. Cacioppo & L. G. Tassinary (Eds.), *Principles of Psychophysiology: Physical, Social and Inferential Elements* (p. 708-774). Cambridge University Press.

Puce, A., Allison, T., & McCarthy, G. (1999). Electrophysiological studies of human face perception iii: Effects of top-down processing on face-specific potentials. *Cerebral Cortex, 9*, 445-458.

Puce, A., Smith, A., & Allison, T. (2000). ERPs evoked by viewing facial movements. *Cognitive Neuropsychology, 17*(1/2/3), 221-239.

Radin, D. (1997). *The Conscious Universe.* San Fancisco: Harper Collins.

Radin, D. (2003). Thinking outside the box: EEG correlations between isolated human subjects. In *Proceedings of the 46th Parapsychology Association Convention* (p. 1784-199). New York: The Parapsychology Association.

Radin, D. (2005). The sense of being stared at: A preliminary meta-analysis [peer commentary on 'the sense of being stared at']. *Journal of Consciousness Studies, 12*(6), 95-100.

Ray, W. J. (1990). The electrocortical system. In J. T. Cacioppo & L. G. Tassinary (Eds.), *Principles of Psychophysiology: Physical, Social and Inferential Elements* (p. 385-412). Cambridge University Press.

Reips, U.-D. (2002). Standards for internet-based experimenting. *Experimental Psychology, 49*(4), 243-256.

Reminick, R. A. (1985). The evil eye belief among the Amhara of Ethiopia. In A. C. Lehmann & J. E. Myers (Eds.), *Magic, Witchcraft and Religion: An Anthropological Study of the Supernatural* (p. 175-151). London: Mayfield Publishing Company.

Riccardelli, P., Baylis, G., & Driver, P. (2000). The positive and negative of human expertise in gaze perception. *Cognition, 77*, B1-B14.

Robbins, B. D. (2003). Comment: The phenomenological truth of visual emissions. *American Psychologist*, *58*(6/7), 494-495.

Robson, K. S. (1967). The role of eye-to-eye contact in maternal-infant attachment. *Journal of Child Psychology and Psychiatry*, *8*, 13-25.

Roe, C. A., Sherwood, S. J., & Holt, N. J. (2004). Interpersonal psi: Exploring the role of the sender in Ganzfeld GESP tasks. *Journal of Parapsychology*, *68*, 361-380.

Rosenthal, G. T., Soper, B., & Tabony, R. S. (1994). *Student beliefs concerning the ability to detect when someone is watching: A revision of the Paranormal Belief Scale.* (Unpublished manuscript, Nicholls State University, USA.)

Rosenthal, G. T., Tabony, R. S., Soper, B., & Rosenthal, A. (1997). Ability to detect covert observation. *Perceptual and Motor Skills*, *85*, 75-80.

Rosenthal, R. (1976). *Experimenter Effects in Behavioural Research.* New York: John Wiley.

Rossion, B., Curran, T., & Gauthier, I. (2002). A defense of the subordinate-level expertise account for the N170 component. *Cognition*, *85*, 189-196.

Russel, D. W. (1990). The analysis of psychophysiological data: Multivariate approaches. In J. T. Cacioppo & L. G. Tassinary (Eds.), *Principles of Psychophysiology: Physical, Social and Inferential Elements* (p. 775-801). Cambridge University Press.

Schlitz, M., & Braud, W. (1997). Distant intentionality and healing: Assessing the evidence. *Alternative Therapies*, *3*(6), 62-73.

Schlitz, M., & LaBerge, S. (1997). Covert observation increases skin conductance in subjects unaware of when they are being observed: A replication. *Journal of Parapsychology*, *61*, 185-195.

Schlitz, M., Wiseman, R., Watt, C., & Radin, D. (in press). Of two minds: Skeptic-proponent collaboration within parapsychology. *British Journal of Psychology.*

Schmidt, S. (2001). Empirische testung der theorie der morphischen resonanz: Können wir entdecken wenn wir angeblikt werden? *Forschende Komplentärmedizin*, *8*, 48-50 [In German].

Schmidt, S., Schneider, R., Binder, M., Bürkle, D., & Walach, H. (2001). Investigating methodological issues in EDA-DMILS: Results from a pilot study. *Journal of Parapsychology*, *65*, 59-82.

Schmidt, S., Schneider, R., Utts, J., & Walach, H. (2004). Distant intentionality and the feeling of being stared at: Two meta-analyses. *British Journal of Psychology*, *95*, 235-247.

Schmidt, S., & Walach, H. (2000). Electrodermal activity (EDA) — State-of-the-art measurement and techniques for parapsychological purposes. *Journal of Parapsychology, 64*, 139-163.

Schneider, R., Schmidt, S., Binder, M., Schäfer, F., & Walach, H. (2003). Respiration-related artifacts in EDA recordings: Introducing a standardized method to overcome multiple interpretations. *Psychological Reports, 93*, 907-920.

Schutter, D. J. L. G., de Haan, E. H. F., & van Honk, J. (2004). Functionally dissociated aspects in anterior and posterior electrocortical porcessing of facial threat. *International Journal of Psychophysiology, 53*, 29-36.

Schwartz, G. E. R., & Russek, L. G. S. (1999). Registration of actual and intended eye gaze: Correlation with spiritual beliefs and experiences. *Journal of Scientific Exploration, 13*(2), 213-229.

Shaw, J. C. (2003). *The Brain's Alpha Rhythms and the Mind: A Review of Classical and Modern Studies of the Alpha Rhythm Components of the Electroencephalogram with Commentaries on Associated Neuroscience and Neuropsychology.* London: Elsevier.

Sheldrake, R. (1981). *A New Science of Life: The Hypothesis of Formative Causation.* London: Blond & Briggs Limited.

Sheldrake, R. (1988). *The Presence of the Past.* London: HarperCollins.

Sheldrake, R. (1994). *Seven Experiments That Could Change the World.* London: Fourth Estate.

Sheldrake, R. (1998). The sense of being stared at: Experiments in schools. *Journal of the Society for Psychical Research, 62*, 311-323.

Sheldrake, R. (1999). The "sense of being stared at" confirmed by simple experiments. *Biology Forum, 92*, 53-76.

Sheldrake, R. (2000). The "sense of being stared at" does not depend on known sensory cues. *Biology Forum, 93*, 209-224.

Sheldrake, R. (2001a). Research on the feeling of being stared at. *Skeptical Inquirer,*(March/April), 58-61.

Sheldrake, R. (2001b). Experiments on the sense of being stared at: The elimination of possible artefacts. *Journal of the Society for Psychical Research, 65*(2), 122-137.

Sheldrake, R. (2002). The sense of being stared at: An experiment at Holma College. *Gränsoverskridaren, 10*, 21-23.

Sheldrake, R. (2003). *The Sense of Being Stared At, and Other Aspects of the Extended Mind.* London: The Random House Group Ltd.

Sheldrake, R. (2005a). The sense of being stared at — Part 1: Is it real or illusory? *Journal of Consciousness Studies, 12*(6), 10-31.

Sheldrake, R. (2005b). The sense of being stared at — Part 2: Its implications for theories of vision. *Journal of Consciousness Studies, 12*(6), 32-49.

Sheldrake, R. (2005c). The non-visual detection of staring: Response to commentators. *Journal of Consciousness Studies, 12*(6), 117-126.

Skrandies, W. (1995). Visual information processing: Topography of brain electrical activity. *Biological Psychology, 40*, 1-15.

Skrandies, W. (2002). Electroencephalogram topography: The fundamental theory of electroencephalography. In J. P. Hornak (Ed.), *The Encyclopaedia of Imaging Science and Technology* (Vol. 1, p. 198-210). New York: John Wiley & Sons.

Smith, M. C. (1993). *An exploratory study on a superstitious belief about perception: Can the unseen looks of another be felt?* (Unpublished Masters thesis, Ohio State University, USA.)

Smith, P. L. (1998). Attention and luminance detection: A quantitative analysis. *Journal of Experimental Psychology: Human Perception and Performance, 24*(1), 105-133.

Stanford, R. G. (1974). An experimentally testable model for spontaneous psi events: I. Estrasensory events. *Journal of the American Society for Psychical Research, 68*, 34-57.

Stevens, P. (2000). Noise, physics and psi: New ideas for research. *International Journal of Parapsychology, 11*, 63-72.

Strom, J. C., & Buck, R. W. (1979). Staring and participants' sex: Physiological and subjective reactive responses. *Personality and Social Psychology Bulletin, 5*, 114-117.

Stuart, G. W., Maruff, P., & Currie, J. (1997). Object-based visual attention in luminance increment detection. *Neuropsychologica, 35*(6), 843-853.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using Multivariate Statistics* (4th ed.). London: Allyn and Bacon.

Tarr, M., & Cheng, Y. D. (2003). Learning to see faces and objects. *TRENDS in Cognitive Sciences, 7*(1), 23-30.

Tarr, M., & Gauthier, I. (2000). FFA: A flexible fusiform area for subordinate-level visual processing automated by expertise. *Nature Neuroscience, 3*(8), 764-769.

Tart, C. T. (1963). Physiological correlates of psi cognition. *International Journal of Parapsychology, 5*, 375-386.

Taylor, M. J., George, N., & Ducorps, A. (2001). Magnetoencephalographic evidence of early processing of direction of gaze in humans. *Neuroscience Letters, 316*, 173-177.

Taylor, M. J., Itier, R. J., Allison, T., & Edmonds, G. E. (2001). Direction of gaze effects on early face processing: Eye-only versus full faces. *Cognitive Brain Research, 10*, 333-340.

Thalbourne, M. A., & Evans, L. (1992). Attitudes and beliefs about, and reactions to, staring and being stared at. *Journal of the Society for Psychical Research, 58*(829), 380-385.

Titchener, E. B. (1898). The feeling of being stared at. *Science, 8*, 895-897.

Titchener, E. B. (1899a). Discussion and correspondence: Lehman and Hansen 'On the Telepathic Problem'. *Science, 9*(210), 36.

Titchener, E. B. (1899b). Discussion and correspondence: Professor James on telepathy. *Science, 9*(228), 686-687.

Titchener, E. B. (1899c). Discussion and correspondence: The telepathic question. *Science, 9*(231), 787.

Troscianko, T., Davidoff, J., Humphreys, G., Landis, T., Fahle, M., Greenlee, M., et al. (1996). Human colour discrimination based on a non-parvocellular pathway. *Current Biology, 6*(2), 200-210.

Tucker, D. M., Dawson, S., Roth, D., & Penland, J. (1985). Regional changes in EEG power and coherence during cognition: Intensive study of two individuals. *Behavioral Neuroscience, 99*, 564-577.

Tutzauer, F. (2003). On the sensible application of familywise alpha adjustment. *Human Communication Research, 29*(3), 455-463.

Tyrrell, G. N. M. (1943/1973). *Apparitions*. London: Collier.

Vanderwolf, C. H. (2000). Are neocortical gamma waves related to consciousness? *Brain Research, 855*(2), 217-224.

Vanhatalo, S., Voipio, J., & Kaila, K. (2005). Full-band EEG (FbEEG): An emerging standard in electroencephalography. *Clinical Neurophysiology, 116*, 1-8.

Vasey, M. W., & Thayer, J. F. (1987). The continuing problem of false positives in repeated measures ANOVA in psychophysiology: A multivariate solution. *Psychophysiology, 24*, 479-486.

Vasiliev, L. L. (1963/2002). *Experiments in Mental Suggestion*. Charlottesville, VA: Hampton Roads.

Velmans, M. (2005). Are we out of our minds? [peer commentary on 'the sense of being stared at']. *Journal of Consciousness Studies, 12*(6), 109-116.

Wackermann, J. (2004). Dyadic correlations between brain functional states: Present facts and future perspectives. *Mind and Matter, 2*(1), 105-122.

Wackermann, J., Seiter, C., Keibel, H., & Walach, H. (2003). Correlations between brain electrical activities of two spatially seperated human subjects. *Neuroscience Letters, 336*, 60-64.

Walach, H., & Schmidt, S. (2005). Repairing Plato's Life Boat with Ocham's Razor. *Journal of Consciousness Studies, 12*(2), 52-70.

Walach, H., Schneider, R., & Chez, R. A. (2003). *Proceedings: Generalized Entanglement from a Multidisciplinary Perspective.* CA, USA: Samueli Institute.

Walter, W. (1937). *The Living Brain.* New York: Norton.

Walter, W. (1953). Electroencephalogram in cases of cerebral tumour. *Proceedings of the Royal Society of Medicine, 30*, 579-598.

Warren, C. A., McDonough, B. E., & Don, N. S. (1992). Event-related brain potential changes in a psi task. *Journal of Parapsychology, 56*, 1-30.

Watanabe, S., Kensaku, M., & Ryusuke, K. (2002). Gaze direction affects face perception in humans. *Neuroscience Letters, 325*, 163-166.

Watt, C., Schlitz, M., Wiseman, R., & Radin, D. (2005). Experimenter differences in a remote staring study. In L. Savva (Ed.), *Proceedings of the Parapsychological Association 48th Annual Convention* (p. 256-260). New York: The Parapsychology Association.

Watt, C., Wiseman, R., & Schlitz, M. (2002). Tacit information in remote staring research: The Wiseman-Schlitz interviews. *The Paranormal Review, 24*, 18-25.

Williams, L. (1983, February). *Minimal cue perception of the regard of others: The feeling of being stared at.* Paper presented at 10th Annual Conference of the Southeastern Regional Parapsychological Association. US: West Georgia College, Corrollton, GA.

Winer, G. A., Cottrell, J. E., Gregg, V., Fournier, J. S., & Bica, L. A. (2002). Fundamentally misunderstanding visual perception: Adults' belief in visual emissions. *American Psychologist, 57*(6/7), 417-424.

Winer, G. A., Cottrell, J. E., Gregg, V., Fournier, J. S., & Bica, L. A. (2003). Comment: Do adults believe in visual emissions? *American Psychologist, 58*(6/7), 495-496.

Winer, G. A., Cottrell, J. E., Karefilaki, K. D., & Chronister, M. (1996). Conditions affecting beliefs about visual perception among children and adults. *Journal of Experimental Child Psychology, 61*, 93-115.

Winer, G. A., Cottrell, J. E., Karefilaki, K. D., & Gregg, V. R. (1996b).

Images, words and questions: Variables that influence beliefs about vision in children and adults. *Journal of Experimental Child Psychology, 63*, 499-525.

Wiseman, R., & Schlitz, M. (1997). Experimenter effects and the remote detection of staring. *Journal of Parapsychology, 61*, 197-207.

Wiseman, R., & Schlitz, M. (1999). Experimenter effects and the remote detection of staring: An attempted replication. In K. S. Dalton (Ed.), *Proceedings of the Parapsychological Association 42nd Annual Convention* (p. 471-479). New York: The Parapsychology Association.

Wiseman, R., & Smith, M. D. (1994). A further look at the detection of the unseen gaze. In D. J. Bierman (Ed.), *Proceedings of the Parapsychological Association 37th Annual Convention* (p. 465-468). New York: The Parapsychology Association.

Wiseman, R., Smith, M. D., Freedman, D., Wasserman, T., & Hurst, C. (1995). Examining the remote staring effect: Two further experiments. In N. Zingrone (Ed.), *Proceedings of the Parapsychological Association 38th Annual Convention* (p. 480-490). New York: The Parapsychology Association.

Woertz, M., Pfurtscheller, G., & Klimesch, W. (2004). Alpha power dependent light stimulation: Dynamics of event-related (de)synchronization in human electroencephalogram. *Cognitive Brain Research, 20*, 256-260.

Yarbus, A. L. (1967). *Eye Movement and Vision.* Translated by B. Haigh. New York: Plenum Press.

Yovel, G., Levy, J., Grabowecky, M., & Paller, K. A. (2003). Neural correlates of the left-visual-field superiority in face perception appear at multiple stages of face processing. *Journal of Cognitive Neuroscience, 15*(3), 462-474.

Zajonc, R. B. (1980). Compresence. In P. B. Paulus (Ed.), *Psychology of Group Influence* (p. 35-60). Hillsdale, NJ: Erbaum.

Appendix A: Baker's (2005) Commentary from the *Journal of Consciousness Studies*

Baker, I. S. (2005). Nomenclature and methodology [Peer commentary on 'the sense of being stared at']. *Journal of Consciousness Studies, 12*, 6, 56-63.

Garety, P.A. & Freeman, D. (1999), 'Cognitive approaches to delusions: A critical review of theories and evidence', *British Journal of Clinical Psychology,* **38**, pp. 113–54.
Green, D.M. & Swets, J.A. (1966), *Signal Detection Theory and Psychophysics* (New York: Wiley).
Grimshaw, G.M., Bulman-Fleming, M.B. & Ngo, C. (2004), 'A signal-detection analysis of sex differences in the perception of emotional faces', *Brain and Cognition,* **54**, pp. 248–50.
Huq, S.F., Garety, P.A., & Hemsley, D.R. (1988), 'Probabilistic judgements in deluded and non-deluded subjects', *Quarterly Journal of Experimental Psychology, A,* **40**, pp. 801–12.
Kaney, S. & Bentall, R.P. (1989), 'Persecutory delusions and attributional style', *British Journal of Medical Psychology,* **62**, pp. 191–8.
Kaney, S., Bowen-Jones, K., Dewey, M.E. & Bentall, R.P. (1997), 'Two predictions about paranoid ideation: Deluded, depressed and normal participants' subjective frequency and consensus judgments for positive, neutral and negative events', *British Journal of Clinical Psychology,* **36**, pp. 349–64.
Kaney, S., Wolfenden, M., Dewey, M.E. & Bentall, R. P. (1992), 'Persecutory delusions and recall of threatening propositions', *British Journal of Clinical Psychology,* **31**, pp. 85–7.
Lyon, H.M., Kaney, S. & Bentall, R.P. (1994), 'The defensive function of persecutory delusions: Evidence from attribution tasks', *British Journal of Psychiatry,* **164**, pp. 637–46.
Sheldrake, R. (1999), 'The "sense of being stared at" confirmed by simple experiments', *Biology Forum,* **92**, pp. 53–76.
Stanislaw, H., & Todorov, N. (1999), 'Calculation of signal detection theory measures', *Behavior Research Methods, Instruments, and Computers,* **31**, pp. 137–49.

IAN S. BAKER[3]

Nomenclature and Methodology

In his first paper Sheldrake attempts to uncover whether or not the 'sense of being stared at' is real or illusory, concluding that 'the great majority of the evidence supports the reality of this sense' (p. 29). I would like to discuss some of the issues that he raises and how they pertain to his central argument and the body of evidence for and against remote staring detection. I will be focussing most of my comments on part one of his paper.

I have divided my comments into three main areas. First, I will discuss the nomenclature that Sheldrake uses in the paper and which is used in the field as a whole to describe this phenomenon and why a consensus is required. Secondly, I will illustrate how there are issues between the different methodologies used in this area concerning two subtly different senses of the concept of ecological validity, namely: realism and generalisability. Finally, I will show how the CCTV-based method offers a superior methodology for the investigation of remote staring detection, and that it represents a considerably different methodology to the other methods listed. This difference, both in terms of the greater robustness and validity when compared to the other approaches, means that the results from the CCTV method have to be considered separately to the other results. This has consequences for the main thrust of the argument that Sheldrake puts forward in this paper.

[3] I would like to thank Paul Stevens and Claudia Coelho for their helpful comments on an earlier version of this commentary.

I: Definition

As Sheldrake notes, the 'sense of being stared at' has been investigated for over 100 years, with the majority of the research being conducted from the early 1990s onwards. I would initially like to raise an important point about the terminology in use in this area. Sheldrake uses the term 'the sense of being stared at' to define what Braud *et al.* (1993a,b) describe anecdotally as '[having the] feeling that someone was staring at you from behind and, upon turning around, [finding out that] you were correct' (1993a, p. 373) and operationally as 'the purported ability to detect when one is being watched or stared at by someone situated beyond the range of the conventional senses' (1993b: p. 391).

However, the term that Sheldrake uses is potentially misleading, as it does not define whether or not the stare is conventional in origin, or beyond the range of the conventional senses. An individual could be uncomfortable due to the sensation provided from someone staring at them directly from the front. I advocate the term '*remote staring detection*', not only because remote staring has been used more often in the research than any other term, but also because it defines the three core elements of this phenomenon; first, due to the way that the experiments are designed they are testing if the individual is *detecting* the stare of another. Secondly, the term '*remote*' makes the clear distinction that we are talking about a stare beyond the range of the conventional senses. Finally, the individual is generally '*staring*', a term that is sometimes removed in other nomenclature defining this phenomenon (e.g., 'unseen gaze', 'covert observation', etc.), although it is of particular importance when defining the nature of the phenomenon. There has been a debate in the social psychology literature on interpersonal interaction about the use of particular terms to describe certain visual interactions, with research demonstrating that the term 'staring' is consistently placed at the most extreme end of a scale in terms of the length of time of an eye-fixation (Kirkland and Lewis, 1976; Baker, 2001). Ellsworth *et al.* (1972), made an important definition of staring for their study examining the social impact of staring when they defined it as 'a gaze or look that persists regardless of the behaviour of the other person' (p. 303). Most eye-based dyadic interactions employ a complex relationship of 'mutual gaze' (Argyle and Cook, 1976; Argyle, 1988) between the two individuals, which provides several different types of communication (Kleinke, 1986). However, staring represents an anomaly to this because it remains fixed regardless of the other person's behaviour. Therefore 'staring' is an important term with which to frame remote staring detection, as the stare from the remote individual continues regardless of the behaviour of the individual being stared at. Although there might be some form of interaction between the two individuals, from a purely descriptive position, the term 'remote staring detection' appears to be more appropriate than any other term used to describe this particular phenomenon.

II: Issues of Ecological Validity

One of the main issues surrounding the research into remote staring detection is ecological validity. This issue is complex, and weaves its way throughout many of the different areas of the literature. For example, is the use of direct looking methods more ecologically valid than the separation of the individuals involved by a CCTV link? Is the use of conscious guessing more ecologically valid than the use of unconscious physiological measures? These questions have implications for the controls used in these experiments and how they might restrict the investigation of the real life phenomenon.

Part of the problem is that one can identify two subtly different meanings of the concept of ecological validity that need to be teased apart in any discussion of the validity of different methods used to investigate remote staring detection. First, there is the issue of *generalisability* — can the data obtained from a particular method be generalised to the real life phenomenon that the experiment is attempting to measure? In relation to this issue the discussion will focus specifically on the extent to which the laboratory-based measurements of electrodermal activity can be assumed to be present in all instances of remote staring detection. Secondly, there is the issue of *realism*, which refers to how closely a particular method recreates the phenomenon as one assumes it happens in 'real life'. In relation to this issue, the discussion will focus on whether or not the direct looking experiments are a closer representation of the real-life phenomenon of remote staring detection than the CCTV laboratory-based experiments. I will now examine both of these issues in detail.

Realism

Throughout his paper, Sheldrake refers to different types of research as evidence for or against remote staring detection, highlighting two particular methodologies: the 'direct looking' and the 'CCTV-based' experiments. These different types of methodology can be broadly placed along the continuum that I have outlined in Figure 1. I have also included two additional approaches that he does not clearly place into this classification; namely his own 'Window' experiments, where the starer and staree[4] are separated by a window (Sheldrake, 2000), and the 'One-way Mirror' experiments, where the starer and staree are separated by a one-way mirror.[5]

Figure 1 demonstrates the methodological development and increasing sophistication of the remote staring detection studies. This development has been gradual over the past 100 years, although some researchers, Sheldrake included, have advocated a return to simpler measures. For example, Sheldrake has argued that

[4] The 'staree' is the individual who is being stared at. The 'starer' is the individual who is doing the staring.

[5] The terms 'one-way' and 'two-way' mirror are interchangeable and refer to a sheet of metal-coated glass which reflects approximately half of the light and allows the rest to pass through it. When placed in a wall between rooms where one room is dark and the other is well lit, it is possible to see clearly through the mirror into the lighter room from the darker one, but it appears to be a normal mirror from the lighter room.

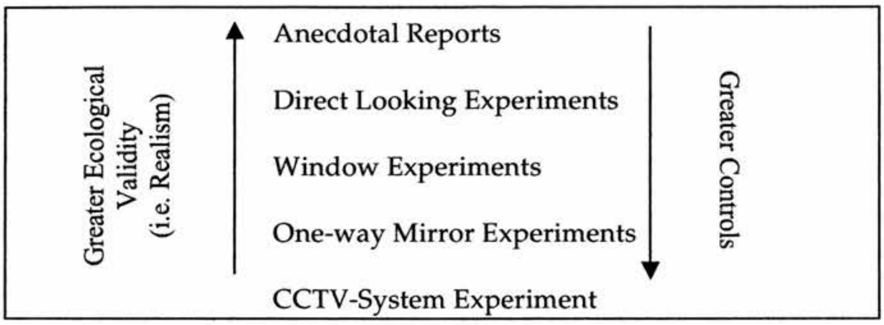

Figure 1. Continuum of remote staring detection studies

'direct-looking tests are far easier to perform than CCTV trials' (p. 14) and that, 'a great advantage of simple experiments in which subjects make conscious guesses is that they enable many more people to take part in this research than the CCTV method. They are also closer to the real life phenomenon' (Sheldrake, 2001, p. 122). He has argued this because typically, with many experiments, as the degree of control over extraneous variables decreases, the degree of the realism element of ecological validity increases (as noted in Figure 1). However, this might not necessarily be the case in the remote staring detection literature.

There has been a dramatic rise in CCTV-systems for everyday surveillance by businesses, and local and national government, particularly in the UK, over the past 10 years. This means that people are observed via CCTV on a daily basis, (as Sheldrake himself notes, p. 22). In fact, it has been estimated, based on surveys on the proliferation of CCTV systems in London, that as of 2003 there were as many as 4.2 million CCTV cameras in the UK, which translates as one camera for every 14 people (McCahill and Norris, 2003, as cited by Norris, McCahill and Wood, 2004). The experiments that used CCTV methodologies recreate this, and therefore are equally ecologically valid to the other methodologies. They are recreating an everyday experience from real life, although it might be different from the type of experience recreated by the direct looking experiments. As Sheldrake notes in his paper (p. 22), and in his previous work (Sheldrake, 2003), his interviews of personnel in the surveillance industry suggest that people do detect being watched via CCTV in real life.

Generalisability

An aspect of methodology where Sheldrake does not draw enough of a distinction in his paper is the difference between conscious and unconscious remote staring detection. Within the literature, conscious measures commonly involve the staree verbally indicating or writing down whether or not they think they are being stared at during a particular epoch.[6] In contrast, the unconscious measures

[6] This refers to a period of time in which a particular stimulus is administered; in this case a remote stare or a rest period (i.e., no stare). Typically these periods last between five to 30 seconds in these experiments.

involve the measurement of the staree's electrodermal activity (EDA) during staring and no-staring epochs.

It is debateable whether or not conscious measures are more ecologically valid than the unconscious measures, as the physiological stimulation provided by a remote stare would most likely act as a precursor to cognitive awareness. Braud *et al.* (1993a) decided to conduct the first study using physiological measures because of this, stating that,

> [remote] staring detection frequently takes the form of spontaneous behavioural and bodily changes. Often, such changes are reported to be rich in physiological content (for example, tingling of the skin, prickling of the neck hairs) and automatic movements (for example, spontaneous head turning, unplanned glances). Higher cognitive functions seem to play minor roles in these staring detection contexts. (Braud *et al.*, 1993a, p. 376–7)

In fact, they also suggest, when discussing previous research using direct looking methodologies employing conscious guessing, that 'such a procedure would be expected to maximise possible cognitive interferences and distortions of subtle internal staring-related cues' (Braud *et al.*, 1993a, p. 376). Therefore, measuring physiological arousal could be more ecologically valid than the behavioural measures, as the information from processing the unconscious, physiological stimulus of the remote stare is not reaching conscious awareness. By measuring the 'pure' unconscious physiological reaction we are avoiding the 'contaminated' cognitive measure. This type of processing of stimuli without conscious awareness has been noted in other areas, such as: change blindness (see O'Regan, 2003, for review) and perception without awareness (see Pessoa, 2005, for review).

III: Can the EDA-CCTV and Direct Looking Methods Be Directly Compared?

The use of EDA measures, with the controls that are implicit in their use, are normally combined with the CCTV method, mainly because of the controls both methods provide, and because they require considerable resources that combine well in the laboratory. These experiments involve separating the starer and staree into different rooms and measuring the EDA of the staree during randomly-scheduled epochs when the starer stares or does not stare at them via the CCTV system. This combination of EDA and CCTV (or EDA-CCTV) provides an even more robust methodology, and *all* of the 15 experiments (from nine studies) that Schmidt *et al.* (2004) included in their meta-analysis of EDA-based remote staring detection studies combined the CCTV method with the physiological measure. Schmidt *et al.* (2004) scrutinised the studies for a variety of issues concerning the veracity of the method, such as: safeguards, the quality of the specific methodology for electrodermal measurement, and overall methodological quality. They found a significant, but small, effect (Cohen's $d = .13$, $p = .01$) across all of the studies.

The size of this effect is also an important factor when comparing the CCTV method with the other methods, particularly the 'direct looking' experiments. Sheldrake claims in his paper that the direct looking experiments have an overall significance[7] value of $p < 1 \times 10^{-20}$ (p. 15). However, as was pointed out above, Schmidt *et al.*'s (2004) meta-analysis found that the EDA-CCTV remote staring detection studies had a far smaller overall significance value of $p = .01$. These significance levels clearly do not match, and the difference between them is readily apparent: *the larger the significance value, the less robust the controls.* Even if a less conservative estimate is used, by examining the meta-analysis of the EDA-based remote staring detection studies by Schlitz and Braud (1997), there is still an enormous discrepancy between the significance of the effect that Sheldrake notes and the significance size that Schlitz and Braud (1997) notes ($r = .25, p = .00005$). There is obviously a significant effect in the remote staring detection studies, as the well-controlled EDA-CCTV studies demonstrate, but there is a strong suggestion that at least part of the disproportionately high significance level of the direct looking experiments could be due to a lack of adequate controls.

The CCTV method has become increasingly divorced from the others in the continuum. Researchers employing the other methodologies in the continuum have gone to great efforts in their attempts to reduce extraneous variables and sources of sensory leakage, but CCTV is the only method that can categorically claim to have achieved this. It does not fall foul of the possible artefacts that Sheldrake describes (p. 21), and he in fact relies upon the results from studies that employed the CCTV method in order to bolster his argument. As soon as these methods are separated and the CCTV method is no longer used to provide support, Sheldrake's arguments against possible artefacts explaining the remote staring effect are forced to rely solely upon less secure methods and unverifiable anecdotal reports. For example, when he argues against 'subtle sensory cues', he states that, 'in addition, positive results in experiments using one-way mirrors and CCTV seem to eliminate the possibility of sensory cues.' When arguing against cheating, he again appeals to methods 'separating lookers and subjects by … one-way mirrors or by closed circuit television' (p. 21) providing positive results to show that this remains an impossible criticism for all of the studies, without any regard for the methodology used. Finally, when arguing against hand scoring errors, he again relies on the CCTV method to bolster his argument as he states 'also, there was no hand scoring in the CCTV trials' (p. 21).

The use of the combined method of CCTV and electrodermal activity measurement demonstrates such a high degree of methodological and conceptual difference when compared to other studies in the continuum, that they might represent remote staring detection under the best controlled circumstances, or they might represent a subtly different phenomenon altogether. The effect sizes noted under these conditions are similar to the effect sizes noted under other

[7] It would have been very useful if Sheldrake had provided an overall effect size in addition to this significance level, and to have had a detailed rationale and description of the process of calculation that led him to conclude this overall level of significance for the direct looking experiments.

DMILS (Direct Mental Interaction between Living Systems) studies that have employed electrodermal activity as a dependent measure (i.e. $d = .11, p = .001$, as reported by Schmidt *et al.*, 2004). It is possible that this represents a similarity between EDA-CCTV and the wider DMILS effects, which might be a related process, but not necessarily the same as the potential remote staring detection effect observed in the direct looking experiments. In the second part of Sheldrake's paper, he discusses remote staring detection and he speculates how it might be related to extramission theory[8] and 'perceptual fields'. However, Sheldrake cannot easily incorporate the findings from the CCTV method, stating, 'the way in which they can help explain the effects of staring through CCTV is obscure' (p. 44), demonstrating that, from his theoretical standpoint, the CCTV method is incomparable with the other methods. We do not yet fully understand the significant effect obtained using the CCTV method, and how these findings are related to the data from the other remote staring detection experiments. We need to clarify the issue with further experimentation examining more detailed physiological reactions to a remote starer separated via a CCTV link, and analysis comparing the validity of the different methods.

IV: Conclusions

There are two main inconsistencies in Sheldrake's argument. First, he relies upon the EDA-CCTV studies to strengthen his argument that the evidence obtained from the direct-looking experiments demonstrate that remote staring detection is a real phenomenon. However, there are considerable methodological differences between these two methods that make a direct comparison difficult. The EDA-CCTV studies are well-controlled laboratory experiments that carefully separate the starer and staree and rely upon unconscious measures. In contrast, the direct-looking experiments cannot incorporate as robust controls due to their very design and their reliance upon conscious guessing. Moreover, the EDA-CCTV studies have demonstrated a significant, if small, effect of remote staring detection on their own, and it is unnecessary to incorporate them with the other, less-controlled studies. It is, however, necessary for the two approaches to stand and be evaluated on their own robustness and validity. The combined EDA-CCTV approach has largely stood up to independent, rigorous statistical and methodological scrutiny, thanks mainly to Schmidt *et al.*'s (2004) meta-analysis; the remote staring detection studies that employed conscious guessing and direct looking have yet to do so.

Secondly, Sheldrake admits in the second part of his paper that the results from the EDA-CCTV studies do not easily fit into the perceptual fields theory that his is advocating to explain remote staring detection. Essentially, in his paper Sheldrake is attempting to have the best of both worlds; he is happy to use the more robust empirical evidence from the EDA-CCTV studies to back up his claims from the direct-looking experiments, but then sidelines the EDA-CCTV

[8] Extramission theory is described as the concept that 'vision involve[s] emissions from the eye' (Cottrell *et al.*, 1996: p. 50).

studies from his perceptual fields theory because there is difficulty in incorporating them conceptually.

In conclusion, I would agree with Sheldrake that there is promising evidence that remote staring detection is a real phenomenon, although there is much research required to reveal its nature. However, the evidence comes almost entirely from the well-controlled EDA-CCTV lab-based studies that need to be considered separately from the other approaches.

References

Argyle, M. (1988), *Bodily Communication* (London: Routledge).

Argyle, M. & Cook, M. (1976), *Gaze and Mutual Gaze* (Cambridge University Press).

Baker, I.S. (2001), *The relationship of gaze-avoidance to shyness and belief in the power of gaze, and an analysis of vocabulary for eye-fixation research.* Unpublished Master's thesis, University of Edinburgh, Edinburgh, Scotland, UK.

Braud, W., Shafer, D. & Andrews, S. (1993a), 'Reactions to an unseen gaze (remote attention): A review, with new data on autonomic staring detection', *Journal of Parapsychology*, **57**, pp. 373–90.

Braud, W., Shafer, D. & Andrews, S. (1993b), 'Further studies of autonomic detection of remote staring: Replications, new control procedures, and personality correlates', *Journal of Parapsychology*, **57**, pp. 391–409.

Cottrell, J.E., Winer, G.A. & Smith, M.C. (1996), 'Beliefs of children and adults about feeling stares of unseen others', *Developmental Psychology*, **32** (1), pp. 50–61.

Ellsworth, P.C., Carlsmith, J.M. & Henson, A. (1972), 'The stare as a stimulus to flight in human subjects: A series of field experiments', *Journal of Personality and Social Psychology*, **21**, pp. 302–11.

Kirkland, J. & Lewis, C. (1976), 'Glance, look, gaze, and stare: A vocabulary for eye-fixation research', *Perceptual and Motor Skills*, **43** (3), p. 1278.

Kleinke, C.L. (1986), 'Gaze and eye contact: A research review', *Psychological Bulletin*, **100** (1), pp. 78–100.

Norris, C., McCahill, M. and Wood, D. (2004), 'The growth of CCTV: A global perspective on the international diffusion of video surveillance in publicly accessible space', *Surveillance and Society*, **2** (2/3), pp. 110–35.

O'Regan, J.K. (2003), 'Change blindness', in *Encyclopaedia of Cognitive Science*, ed. L. Nadel (London: Nature Publishing Group).

Pessoa, L. (2005), 'To what extent are emotional visual stimuli processed without attention and awareness?', *Current Opinion in Neurobiology*, **15**, pp. 188–96.

Schlitz, M. & Braud, W. (1997), 'Distant intentionality and healing: Assessing the evidence', *Alternative Therapies*, **3** (6), pp. 62–73.

Schmidt, S., Schneider, R., Utts, J. & Walach, H. (2004), 'Distant intentionality and the feeling of being stared at: Two meta-analyses', *British Journal of Psychology*, **95**, pp. 235–47.

Sheldrake, R. (2000), 'The "sense of being stared at" does not depend on known sensory cues', *Biology Forum*, **93**, pp. 209–24.

Sheldrake, R. (2001), 'Experiments on the sense of being stared at: The elimination of possible artefacts', *Journal of the Society for Psychical Research*, **65**, pp. 122–37.

Sheldrake, R. (2003), *The Sense of Being Stared At, And Other Aspects of the Extended Mind* (London: Hutchinson).

Appendix B: Data Processing Scripts

Example Tck/TL Script used to analyse the ERP & GFP data

```
# Tcl BATCH file for ERP analysis of Remote Staring ERP/GFP.
# Written by Ian Baker (c) 2005.

set path "C:\\Documents and Settings\\Experimental\\My Documents\\Ian Baker\\Analysis
\\ERP Analysis\\" # Path for Analysis machine

set file "XX" ;# This file can be re-named each time in order to perform this
programmed analysis on any core CNT file in the above directory path

set cnt .cnt
set eeg .eeg
set avg .avg
set ev2 .ev2
set corr corr
set LD _LD
set LDOAR _LDOAR
set LDOARFil _LDOARFil
set All _All
set AllBase _AllBase
set Rej _Rej
set ERP _ERP
set Face _Face
set Face-Ocular _Face-Ocular
set Face+Remote _Face+Remote
set Face+Remote-Ocular _Face+Remote-Ocular

# GFP settings
set FaceGFP _FaceGFP
set Face+RemoteGFP _Face+RemoteGFP


OPENFILE "$path$file$cnt" ;# opens the inital cnt file

#PAUSE ;# To correct the Event File
```

```
LDR "C:\\Documents and Settings\\Experimental\\My Documents\\Ian Baker\\Analysis
\\BipVEOG2.ldr" "$path$file$LD$cnt" ;# applies
the linear derivation file to combine the vertical ocular channels into one
bipolar channel

OPENFILE "$path$file$LD$cnt"
ARTCOR POSITIVE 10 30 400 BipVEOG LDR+CNT {ARTRED.LDR} "$path$file$LDOAR$cnt" Y N ;
# applies the ocular artefact reduction

OPENFILE "$path$file$LDOAR$cnt"
FILTER_EX BANDPASS ANALOGSIMULATION 1 24 30 24 x x x N FIR { ALL }
"$path$file$LDOARFil$cnt" ;# applies the bandpass filter

OPENFILE "$path$file$LDOARFil$cnt"
CREATESORT SORT369 ;# sets-up the epoching sort routine
SORT369 -TypeEnabled T
SORT369 -TypeCriteria 4,6,8,10 ;# ensures that all four conditions are used in the
epoching sort
EPOCH_EX EVENTFILE "$path$file$corr$ev2" Y -100 800 N Y Y N N SORT369
"$path$file$LDOARFil$All$eeg" ;# takes -100 to +800 ms and epochs all four
conditions
DELETESORT SORT369 ;# deletes the sort routine

OPENFILE "$path$file$LDOARFil$All$eeg"
BASECOR_EX PRESTIMINTERVAL x x { ALL } "$path$file$LDOARFil$AllBase$eeg" ;
# baselines corrects to the pre-stimulus interval

OPENFILE "$path$file$LDOARFil$AllBase$eeg"
ARTREJ_EX REJCRITERIA Y x x Y -75 75 Y Y { Fp1 Fp2 FT9 FT10 F7 F8 F3 F4 Fz FT7 FT8
FC3 FC4 FCz T7 T8 C3 C4 Cz TP7 TP8 CP3 CP4 CPz P7 P8 P3 P4 Pz P1 P2 A1 A2 O1 O2 Oz }
 ;# rejects any epochs with artefacts at -75 to +75 mV on all channels except for
BipVEOG, HEOGL and HEOGR
PAUSE ;# Will pause the BATCH file until the Resume button is pressed. This is in
order to allow manual inspection for any artifacts the automated rejction routine
has missed
SAVEAS "$path$file$LDOARFil$AllBase$Rej$eeg" ;# saves the artifact rejection files
CLOSEFILE "$path$file$LDOARFil$AllBase$eeg" ;# closes the baseline correction file

# begins the averaging for the FACE (4) stimulus
OPENFILE "$path$file$LDOARFil$AllBase$Rej$eeg"
CREATESORT SORT370
SORT370 -TypeEnabled T
SORT370 -TypeCriteria 4
AVERAGE_EX TIME Y AMPLITUDE 10 COSINE PRESTIMINTERVALNOISE x x
POSTSTIMINTERVALSIGNAL x x SORT370 "$path$file$ERP$Face$avg"
DELETESORT SORT370
OPENFILE "$path$file$ERP$Face$avg"
EXTRACT { Fp1 Fp2 FT9 FT10 F7 F8 F3 F4 Fz FT7 FT8 FC3 FC4 FCz T7 T8 C3 C4 Cz TP7 TP8
CP3 CP4 CPz P7 P8 P3 P4 Pz P1 P2 O1 O2 Oz } "$path$file$ERP$Face-Ocular$avg" ;
# extracts the ocular and ear channels
OPENFILE "$path$file$ERP$Face-Ocular$avg"
REFER Y N N { Fp1 Fp2 FT9 FT10 F7 F8 F3 F4 Fz FT7 FT8 FC3 FC4 FCz T7 T8 C3 C4 Cz TP7
TP8 CP3 CP4 CPz P7 P8 P3 P4 Pz P1 P2 O1 O2 Oz } "$path$file$FaceGFP$avg" ;
# adds the GFP & REF channels
CLOSEFILE "$path$file$LDOARFil$AllBase$Rej$eeg"

# begins the averaging for the FACE + REMOTE (6) stimulus
```

```
OPENFILE "$path$file$LDOARFil$AllBase$Rej$eeg"
CREATESORT SORT371
SORT371 -TypeEnabled T
SORT371 -TypeCriteria 6
AVERAGE_EX TIME Y AMPLITUDE 10 COSINE PRESTIMINTERVALNOISE x x
POSTSTIMINTERVALSIGNAL x x SORT371 "$path$file$ERP$Face+Remote$avg"
DELETESORT SORT371
OPENFILE "$path$file$ERP$Face+Remote$avg"
EXTRACT { Fp1 Fp2 FT9 FT10 F7 F8 F3 F4 Fz FT7 FT8 FC3 FC4 FCz T7 T8 C3 C4 Cz TP7 TP8
CP3 CP4 CPz P7 P8 P3 P4 Pz P1 P2 O1 O2 Oz } "$path$file$ERP$Face+Remote-Ocular$avg" ;
# extracts the ocular and ear channels
OPENFILE "$path$file$ERP$Face+Remote-Ocular$avg"
REFER Y N N { Fp1 Fp2 FT9 FT10 F7 F8 F3 F4 Fz FT7 FT8 FC3 FC4 FCz T7 T8 C3 C4 Cz TP7
TP8 CP3 CP4 CPz P7 P8 P3 P4 Pz P1 P2 O1 O2 Oz } "$path$file$Face+RemoteGFP$avg" ;
# adds the GFP & REF channels
CLOSEFILE "$path$file$LDOARFil$AllBase$Rej$eeg"

CLOSEALL

#}
```

Example PERL Script used to extract the ERP & GFP data from Area Reports

```
#(c) 2005, Ian Baker.
#!/usr/bin/perl
$datadir=$ARGV[0];
$status=opendir(DIR,$datadir); # Select data directory
#@filearray = grep { !/^\./ } readdir(DIR); # filter out dot-files
@filearray = grep { /\.dat/ } readdir(DIR); # only dat-files
closedir(DIR);
open(SAVEHANDLE, ">ERPSummary_$datadir.dat") or die "Couldn't open ERPSummary_$datadir.dat";
print SAVEHANDLE "Ps,Condition,Fp1,Fp2,FT9,FT10,F7,F8,F3,F4,FZ,FT7,FT8,FC3,FC4,FCz,T7,T8,C3,
C4,Cz,TP7,TP8,CP3,CP4,CPz,P7,P8,P3,P4,Pz,P1,P2,O1,O2,Oz,GFP,REF";

foreach $filename (@filearray) {
($Ps,$Condition)=split(/_/,$filename); # split filename on underscore
$Condition=substr($Condition,0,$#Condition-3);# remove last 4 characters (.dat)
print SAVEHANDLE "\n$Ps,$Condition";
open (FILEHANDLE, "$datadir/$filename") || print "ERROR";
   @DataArray=<FILEHANDLE>; # load file contents into array
close (FILEHANDLE);
@DataArray=@DataArray[1 .. $#DataArray]; # remove first line
$mean=0;
$num=0;
foreach (@DataArray) {
($dummy,$electrode,$value)=split(/\t/,$_); # split current line at tab
$value =~ s/\s//g; # remove whitespaces using pattern matching
print SAVEHANDLE ",$value";
}
}
close(SAVEHANDLE);
```